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Vol. VI APRIL, 1919 No. 4

BOSTON SOCIETY OF CIVIL ENGINEERS
FOUNDED 1848

PROCEEDINGS

PAPERS IN THIS NUMBER.

Address at the Annual Meeting. Chas. M. Spofford.

"The Disposal of Sewage by Treatment with Acid." Edgar S. Dorr and Robert Spurr Weston.

Memoirs of Deceased Members.

CURRENT DISCUSSION.

Paper.	Authors.	Published.	Discussion Closes.
"The Boston Army Supply Base."	Frederic H. Fay. Charles R. Gow. Wm. H. Kearns. Charles M. Spofford.	March.	May 10.

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Contributors are hereby notified that proof will not be submitted to them for examination unless requested before the 10th of the month preceding the month of publication.

MINUTES OF THE MEETING.

BOSTON, March 19, 1919. — The seventy-first annual meeting of the Boston Society of Civil Engineers was held at the Boston City Club, Ashburton Place, Boston, on Wednesday, March 19, 1919.

The thirty-seventh annual dinner which preceded the business meeting was served in the auditorium of the Clubhouse, at half past one o'clock, the President of the Society, Prof. Charles M. Spofford, presiding.

There were 153 members and guests seated at the tables, and a number of members who were not able to be present at the dinner joined the party before the after-dinner discussion began.

The discussion was opened by the principal guest of the Society, Gen. R. C. Marshall, Jr., chief of Construction Division, United States Army, with a most interesting and carefully prepared paper on "Cost-Plus Contracts," as carried out by the Construction Division in Government war construction work. He was followed by Col. Frank M. Gunby, in charge of Engineering Branch of Construction Division, and a member of the Society, who with the aid of lantern slides described some of the cantonment work of the division, and gave some idea of the diversified character of the problems and construction work with which it had to deal.

Past President Charles R. Gow, the next speaker, took up especially the cost-plus form of contract as applied to the construction of the Boston Army Supply Base at South Boston. Admiral Homer R. Stanford, civil engineer, United States Navy, a guest of the Society, described briefly some of the construction work done by the Navy Department during the war.

Mr. William F. Kearns, president of the W. F. Kearns Company, the general contractors for the Boston Army Supply Base, spoke of that work from the contractor's point of view, and Past President Charles T. Main discussed briefly the merits of the cost-plus form of contract and those of the lump-sum form.

On motion of Past President Fay, a unanimous vote of thanks was extended to General Marshall and Admiral Stanford for their interesting and instructive contributions to the discussion. Mr. Fay regretted that he could not include the others who had taken part in the discussion in the vote of thanks, because it was an unwritten law that members of the Society should not receive such a vote.

At 5.10 o'clock the business meeting was called to order by President Spofford, in the large banquet room on the ninth floor of the Clubhouse. There were about 80 members present.

The record of the February meeting of the Society was read and accepted.

The Secretary reported for the Board of Government that it had elected this afternoon to membership in the Society, Mr. Clarence Reeds in the grade of Member and Messrs. Arthur D. Dickson and Patrick McGovern in the grade of Associate. He also reported that Mr. Herbert A. Wilson, a former member of the Society who resigned, had been reinstated to membership.

The Secretary presented the memoir of Charles H. Dodd, prepared by a committee consisting of Edgar S. Dorr and Richard J. McNulty, and by vote it was accepted and ordered printed in the JOURNAL.

The annual reports being in order, the Secretary read the report of the Board of Government, and by vote it was accepted and placed on file.

The report of the Treasurer was read by that official, and by vote it was accepted and placed on file.

The Secretary read his report and that of the Committee on the Library, and by vote each was accepted and placed on file.

In the absence of the chairman of the Committee on Social Activities, the Secretary read the report of that committee, and by vote it was accepted and placed on file.

Past President Hale presented and read the report of the Committee on Run-Off Available for Water-Power Purposes, and by vote it was accepted and the committee continued.

By vote, the reappointment of the other committees of the Society was referred to the Board of Government with full powers.

The tellers of election, Messrs. N. S. Brock and H. B. Wood, submitted the result of the letter ballot for officers of the Society, and in accordance with their report the President announced that the following officers had been elected:

President — Leonard Metcalf.
Vice-President (for two years) — Robert Spurr Weston.
Secretary — S. Everett Tinkham.
Treasurer — Frank O. Whitney.

Directors (for two years) — Sturgis H. Thorndike and Arthur S. Tuttle.

Members of Nominating Committee (to serve two years) — David A. Ambrose, Harold K. Barrows and Frank A. Marston.

The President then, with appropriate words, presented the Desmond FitzGerald Medal for the best paper read before the Society, to Mr. Stephen DeM. Gage for his paper entitled, "Sanitary Control of Swimming Pools." Mr. Gage on receiving the medal expressed his deep appreciation of and sincere thanks for the honor thus accorded him.

On motion of Mr. C. W. Sherman, the following vote was unanimously adopted:

Voted: That the dues of all members in the military or naval service of the United States or its allies be abated on request for the proportional part of the year 1919–20 that they remain in the service; and that a sum not exceeding five hundred dollars be appropriated from the income of the Permanent Fund to reimburse the Current Fund of the Society.

The retiring President, Charles M. Spofford, then delivered the annual address of the president, which will be printed in the April number of the JOURNAL.

The President then introduced the President-elect, Mr. Leonard Metcalf, who expressed his appreciation of the confidence accorded him by his election and his sincere thanks for the honor.

At 6.20 o'clock the meeting adjourned to participate in the annual smoker which was held in the auditorium of the club.

The program was similar to that of former years. The members found light refreshments awaiting them as they entered the auditorium, and an abundant supply of pipes and tobacco was at hand. Music was furnished throughout the evening by an orchestra of six pieces, and as usual the special songs of the Society were sung, as well as many of the popular songs of the day, under the leadership of Mr. Charles R. Berry, of the committee of arrangements. The entertainment provided was somewhat of an innovation, consisting of readings and recitations by Mr. LaRue Vredenburgh, acrobatic stunts by a Japanese student from the Massachusetts Institute of Technology, and an athletic exhibition, which took the form of a wrestling match, by two students from the same institution.

The informal reception to the new officers and to those members who had joined the Society during the year, a feature inaugurated last year, was repeated.

The attendance at the smoker was 200 and the attendance of members and guests at the several functions was 275.

S. E. Tinkham, *Secretary.*

Annual Meeting of the Sanitary Section.

Boston, Mass., March 5, 1919. — The annual meeting of the Sanitary Section of the Boston Society of Civil Engineers was held this evening at the Boston Engineers' Club.

The meeting was called to order at eight o'clock by the Vice-Chairman, Mr. E. S. Dorr.

The minutes of the last meeting (held December 4, 1918) were accepted, without reading.

The annual report of the Executive Committee was read by the Clerk, and it was voted that it be accepted and placed on file.

The report of the Nominating Committee was read by the chairman of that committee, submitting the following nominations for officers, for the ensuing year:

For Chairman — Edgar S. Dorr.
For Vice-Chairman — Henry A. Varney.
For Clerk — John P. Wentworth.

For additional members of the Executive Committee:

George E. Russell.
Henry T. Stiff.
George A. Sampson.

There were no other nominations.

It was voted that the Clerk be instructed to cast one ballot for the officers as nominated, and they were declared elected for the ensuing year.

No other committee reports were submitted.

After the business meeting, Lieut.-Col. George A. Johnson, of the Maintenance and Repair Branch of the Construction Division of the United States Army, gave an exceedingly interesting description of the Operation and Maintenance of the Utilities at Army Camps and Cantonments.

Major Richard Messer described, in detail, the sewage-disposal system used in the cantonments.

A stenographer's record of the meeting was made, which will be printed in the Society JOURNAL.

Forty-three members and guests were present.

The meeting adjourned at 10.15 P.M.

HENRY A. VARNEY, *Clerk.*

Previous to the meeting, a dinner was given in Colonel Johnson's honor, in the club dining room. Forty-one members and guests were present.

ANNUAL REPORTS.

REPORT OF THE BOARD OF GOVERNMENT FOR THE YEAR 1918–1919.

BOSTON, MASS., March 19, 1919.

To the Boston Society of Civil Engineers :

Pursuant to the requirements of the Constitution, the Board of Government presents its report for the year ending March 19, 1919.

The total membership of the Society a year ago was 917, of whom 813 were members, 64 juniors, 8 honorary members, 26 associates and 6 were members of the Sanitary Section only.

During the year 23 members have resigned, 20 have forfeited membership for non-payment of dues, the membership of 5 juniors has ceased because of age limit, and 15 have died, making total deductions 63.

Thirty-four new members have been added during the year, of whom 7 are former members reinstated; and 4 juniors have been transferred to the grade of member. Three applicants who have been elected have not completed their membership.

The present membership of the Society consists of 8 honorary members, 791 members, 57 juniors, 26 associates and 6 who are members of the Sanitary Section only, making total membership 888.

The loss by death during the year has been 15. The record is as follows:

Frank S. Hanf, died April 28, 1918.
Howard L. Coburn, died June 19, 1918.
Edward A. Buss, died August 18, 1918.
George M. Stevens, died September 19, 1918.
Leslie P. Reed, died September 26, 1918.
James Hayes, Jr., died September 26, 1918.
George R. Burnes, died October 3, 1918.
Harrie L. Whitney, died October 14, 1918.
Charles H. Dodd, died October 27, 1918.
Rufus M. Whittet, died December 15, 1918.
Charles C. Dotten, died December 28, 1918.
Frederick Brooks, died January 10, 1919.
Fred E. Sauer, Jr., died January 15, 1919.
Gilbert Hodges, died February 13, 1919; and
John S. Humphrey, died February 15, 1919.

Two of these, Frank S. Hanf and Leslie P. Reed, died in the war service.

Under authority of By-Law 8, the Board of Government has remitted the dues of 5 members.

Under a vote of the Society passed at the annual meeting last year, the dues of 109 members have been abated on account of war service, and under the same vote the sum of $782 has been transferred from the income of the Permanent Fund to the Current Fund, to make good the loss in the yearly income of the Society.

Only nine regular meetings have been held during the year. The October meeting was omitted in compliance with the request of the Health Department of Boston, that public meetings be given up during the influenza epidemic.

The average attendance at these meetings was 125, the largest being 260 and the smallest 25.

The following papers and addresses have been given:

March 20, 1918. — Address of the retiring President, George C. Whipple, "The Engineer in the New Democracy." Mr. Robert Ridgway of New York, "Some Features of the New York City Rapid Transit System" (illustrated).

April 17, 1918. — Commander H. R. Stanford, U. S. N., "The Pearl Harbor Dry Dock, Hawaii" (illustrated).

May 15, 1918. — Stoughton Bell, Esq., "Cambridge, Mass., System of Real Estate Assessment" (illustrated).

June 19, 1918. — Major Kenneth D. Marlatt, of the Fourth Canadian Mounted Rifles, "War Condition in France."

September 25, 1918. — Clarence T. Fernald and John C. Moses, "Notes on the Construction of Mystic River Bridge, Boston" (illustrated).

November 20, 1918. — Mr. William A. Donnelly, of New York, "Pontoon Floating Dry Docks, their Construction and Use" (illustrated).

December 18, 1918. — A series of papers on the Boston Army Supply Base by Frederic H. Fay, Charles R. Gow, William F. Kearns and Charles M. Spofford (illustrated).

January 22, 1919. — Edgar S. Dorr and Robert Spurr Weston, "The Disposal of Sewage with Acid Treatment" (illustrated).

February 19, 1919. — Mr. Isaac W. Litchfield, on "The U. S. Employment Service, Department of Labor." George F. Swain, "The Engineering Conditions and Problems in France."

The Sanitary Section has held four meetings and two excursions during the year. The following papers have been presented at the meetings of the Section:

March 6, 1918. — Charles H. Parker, "Economy in the Use of Fuel in Power Stations."

May 1, 1918. — W. W. Peters, of Shanghai, China, illustrated lecture on "Health Education in China."

November 15, 1918. — Lieutenant-Colonel Brooks, Major Harrington and Lieutenant Mathes, "Spanish Influenza, Its Cause and Treatment."

December 4, 1918. — W. L. Stevenson, "Sanitation of the Emergency Shipyards."

The excursions were to L Street Power Plant of the Edison Electric Illuminating Company, on March 6, 1918, and to the Worcester Sewage Purification Works on June 5, 1918.

The amount reported last year as contributed to the fund for the purchase of equipment for the 101st Regiment of the U. S. Engineers, in addition to that previously turned in, has been paid in to the regimental fund during the year, making the total amount contributed, $2 226.58.

In May last a request was received for a contribution to the athletic fund of the 602d Regiment of U. S. Engineers, and in response the sum of $585 was raised and turned over to the regiment before it left for France.

The number of stars on the war-service banner hung in the Society rooms has been increased to 127, which represents, so far as information has been received, the number of members of the Society who have entered the war service of their country. Three of these stars are in gilt, designating those of our members who have lost their lives in response to their country's call.

The committee on matters of interest to engineers coming before the Massachusetts legislature has been continued during the year.

At the May and June meetings of 1917, the sum of $500 was appropriated from the income of the Permanent Fund for the improvement and furnishing of the Society rooms; the total amount expended, last year and this year, is $475.08.

The report of the Editor of the JOURNAL for the calendar year 1918 shows that a total of 735 pages were printed in the ten issues, at a cost of $2 367.75, or $3.22 per page, as against $1 997.44, or $2.54 per page, in 1917.

At the last annual meeting it was voted unanimously to abate the dues of all members for the year 1918–19 who were in the military or naval service of the United States or its allies and to appropriate from the income of the Permanent Fund a sum sufficient to reimburse the Current Fund for the resulting loss.

There has been added to the Permanent Fund of the Society, notwithstanding the amount appropriated for the payment of dues of war members, the sum of $1 779.59. The present value of this fund is $43 467.51, and, with the Edward K. Turner Fund amounting to $1 063.22, makes the total of the permanent funds of the Society $44 530.73.

In accordance with the recommendation of the committee appointed to consider the award of the Desmond FitzGerald medal for the best paper by a member of the Society published for the year ending September, 1918, the Board awards that medal to Stephen DeM. Gage, for his paper entitled "The Sanitary Control of Swimming Pools."

For the Board of Government,

CHARLES M. SPOFFORD, *President.*

REPORT OF THE TREASURER.

BOSTON, March 1, 1919.

To the Boston Society of Civil Engineers :

Your Treasurer presents the following report for the year ending March 1, 1919:

Detailed data are contained in the appended tabular statements; Table 1 gives the receipts and expenditures for the year; Table 2, comparative balance sheets; Table 3, investment of the permanent funds.

The revenue applicable to current expenses has been $8 372.88, being $585.52 less than for the preceding year. The current expenses were $8 641.68. The amount of cash on hand is $109.04.

The expense of the JOURNAL has been more than the previous year by $94.40, and the income from advertisements has been $145.77 less than for the preceding year.

There has been an increase in the Permanent Fund of $1 779.59 after transferring from the income $782 for dues of members in the war.

There has been $188 invested in six per cent bonds of the American Telephone and Telegraph Company.

Respectfully submitted,

FRANK O. WHITNEY, *Treasurer.*

TABLE 1. — RECEIPTS AND EXPENDITURES.

CURRENT FUND.

Receipts.

Balance from March, 1918	$377.84
Members' dues	6 363.74
Members' dues paid from income of Permanent Fund	782.00
Advertisements	1 125.50
Sales of JOURNALS	86.60
Library fines	5.36
Interest on bank balances	9.68
	$8 750.72

Expenditures.

JOURNAL		$3 531.32
Printing, stationery, postage and library supplies (net)		507.08
Rent (net)		1 757.08
Light		58.21
Salaries (except editor)		2 093.00
Reporting		108.50
Stereopticon		22.55
Books		10.90
Binding		93.70
Periodicals		92.61
Incidentals		106.90
Insurance		37.66
Annual meeting and dinner		168.02
Sanitary Section, reporting	$10.00	
Stereopticon	9.00	
Incidentals	35.15	54.15
Cash on hand		109.04
		$8 750.72

PERMANENT FUND.

Receipts.

Entrance fees	$260.00
Contribution	100.00
Interest	1 827.87
Returned from Furnishing Fund	24.92
	$2 212.79

Expenditures.

Deficit, March 1, 1918	$34.18
Coöperative bank dues	900.00
Am. Tel. & Tel. Co. bonds purchased	188.00
Transferred to members' dues	782.00
Cash on hand, March 1, 1919	308.61
	$2 212.79

E. K. TURNER LIBRARY FUND.

Cash on hand March, 1918	$29.37
Interest on bond	50.00
	$79.37
Books purchased	$9.90
Cash on hand March, 1919	69.47
	$79.37
1 Bond Am. Tel. & Tel. Co., book value	$993.75
Cash	69.47
Total value of fund	$1 063.22

FURNISHING APPROPRIATION.

Cash, March, 1918	$105.92
Expended	$81.00
Returned to Permanent Fund	24.92
	$105.92

TABLE 2. — COMPARATIVE BALANCE SHEETS.

Assets.	March 1, 1916.	March 1, 1917.	March 1, 1918.	March 1, 1919.
Cash	$3 163.37	$1 443.47	$478.95	**$487.12**
Bonds and notes	30 366.25	33 318.75	34 835.00	**35 023.00**
Stock	1 950.00	1 950.00	1 950.00	**1 950.00**
Coöperative banks	4 190.96	4 747.15	5 930.85	**7 179.65**
Library	7 500.00	7 500.00	7 500.00	**7 500.00**
Furniture	2 405.11	2 405.11	2 405.11	**2 405.11**
	$49 575.69	$51 364.48	$53 099.91	**$54 544.88**
Liabilities.				
Permanent Fund	$37 475.69	$39 888.17	$41 687.92	**$43 467.51**
E. K. Turner Fund	1 000.00	997.87	1 023.12	**1 063.22**
Unexpended appropriations	....	....	105.92	....
Current funds	1 194.89	573.33	377.84	**109.04**
Surplus	9 905.11	9 905.11	9 905.11	**9 905.11**
	$49 575.69	$51 364.48	$53 099.91	**$54 544.88**

TABLE 3. — INVESTMENT OF THE PERMANENT FUND, MARCH 1, 1919.

Bonds.	Par Value.	Actual Cost.	Value as Carried on Books.
American Tel. & Tel. Co. Col. Tr. 4%, 1929	$3 000.00	$2 328.75	$2 737.50
Union Elec. Light & Power Co. 5%, 1932	2 000.00	2 050.00	2 050.00
Blackstone Valley Gas & Elec. Co. 5%, 1939	2 000.00	1 995.00	1 995.00
Dayton Gas Co. 5%, 1930	2 000.00	2 000.00	2 000.00
Milford & Uxbridge St. Ry. 7%, 1923	3 000.00	2 942.50	2 942.50
Railway & Light Securities Co. 5%, 1939	3 000.00	3 000.00	3 000.00
Superior Light & Power Co. 4%, 1931	4 000.00	3 347.50	3 347.50
Wheeling Electric Co. 5%, 1941	4 000.00	3 845.00	3 845.00
Economy Light & Power Co. 5%, 1956	1 000.00	990.00	990.00
Tampa Electric Co. 5%, 1933	2 000.00	2 000.00	2 000.00
Galveston Houston Elec. Ry. Co. 5%, 1954	2 000.00	1 940.00	1 940.00
Northern Texas Elec. Co. 5%, 1940	2 000.00	1 932.50	1 932.50
Chicago & Northwestern Ry. 5%, 1987	1 000.00	1 102.50	1 102.50
Vermont Power & Mfg. Co. 5%, 1928	1 000.00	965.00	965.00
Am. Tel. & Tel. Co. 5%, 1946	1 000.00	993.75	993.75
United States Liberty Loan 3½%, 1947	2 000.00	2 000.00	2 000.00
American Tel. & Tel. Co. 6%, 1925	200.00	188.00	188.00
	$35 200.00	$33 620.50	$34 029.25

Stock.

15 shares Am. Tel. & Tel. Co.	1 500.00	1 950.00	1 950.00
Total Securities	$36 700.00	$35 570.50	$35 979.25

Coöperative Banks.

25 shares Merchants Coöperative Bank, including interest to March	$2 293.75
25 shares Volunteer Coöperative Bank, including interest to January	2 581.70
25 shares Watertown Coöperative Bank, including interest to March	2 304.20
	$7 179.65
Total value of invested funds	$43 158.90
Cash on hand	308.61
Total value of Permanent Fund	$43 467.51

E. K. Turner Fund.	Par Value.	Actual Cost.		
Am. Tel. & Tel. C. 5%, 1946	$1 000.00	$993.75	$993.75	
Cash on hand			69.47	
				1 063.22
				$44 530.73

We have examined the above report and found it correct.

John L. Howard,
Edwin H. Rogers,
Auditing Committee of Directors of the Boston Society of Civil Engineers.

Report of the Secretary, 1918–19.

Boston, March 19, 1919.

S. Everett Tinkham, Secretary, *in account with the* Boston Society of Civil Engineers.

For cash received during the year ending March 19, 1919, as follows:

From entrance fees, new members and transfers:

21 members and associates	at $10 =	$210.00	
6 juniors	at 5 =	30.00	
4 juniors transferred to members	at 5 =	20.00	
Total from entrance fees			$260.00

From annual dues for 1918–19, including dues from new members	$6 257.74	
From back dues	44.00	
From dues for 1919–20	62.00	
Total from dues		6 363.74
From rents		1 272.92
From advertisements		1 125.50
From sale of JOURNALS, reprints and cuts		86.60
From library fines		5.36
From contribution to building fund		100.00
Total		$9 214.12

The above amount has been paid to the Treasurer, whose receipts the Secretary holds.

We have examined the above report and found it correct.

JOHN L. HOWARD,
EDWIN H. ROGERS,
Auditing Committee of Directors of the
Boston Society of Civil Engineers.

REPORT OF LIBRARY COMMITTEE, 1918–19.

BOSTON, MASS., March 19, 1919.

To the Boston Society of Civil Engineers :

The Library Committee submits the following report for the year 1918–19.

Since the last report, 114 volumes bound in cloth and 403 bound in paper have been added to the library, making a total of 517 accessions.

There are now 9 524 cloth-bound volumes in the library, and those bound in paper number about 2 700.

During the year 283 books have been loaned to members — a slight increase over last year — and fines to the amount of $5.36 have been collected.

Less binding has been done this year than during any recent year, chiefly on account of the increased difficulty — due to war conditions — in maintaining complete files of periodicals and reports, and the delay of publishers, not only in getting out the necessary title-pages and indexes, but also in mailing them after publication. A number of publishers who formerly sent title-pages and indexes to all subscribers have now apparently adopted the policy of sending them only on request.

The decrease in the amount of binding done is of course largely responsible for the comparatively small number of accessions this year, although this may also be accounted for in part by the fact that fewer reports of engineering interest have been issued by government departments and private concerns than in previous years. A tendency toward an increased output both in reports and engineering text-books may be already noted, however, since the signing of the armistice, and another year will probably see matters well on their way toward normal.

The number of subscriptions to periodicals has increased materially, and the exchange list of the Society's JOURNAL has dwindled proportionately, as a result of the ruling of the War Industries Board in regard to free and exchange lists. Although this ruling provided that publishers might still retain upon their free lists libraries that agreed to bind their publications for permanent keeping, comparatively few were willing to make this exception, the majority preferring to avail themselves of the opportunity to abolish their free lists.

Twelve new books on engineering subjects have been added to Section 10, nine by purchase. Three of the remaining four, — "Concrete Engineers' Handbook," by Hool and Johnson; "American Engineers behind the Battle Lines in France," by R. K. Tomlin, Jr.; and "Sewage Disposal," second edition, by Kinnicutt, Winslow and Pratt, were donated by their respective publishers for review, and a copy of "Plumbing and Household Sanitation," by J. Pickering Putnam, was the gift of Mrs. Putnam.

A number of contributions have been received from Mr. Desmond FitzGerald and Mr. Howard A. Carson.

The Catalogue Equipment and Supply Company have continued their good work in keeping up to date the collection of trade catalogues known as "Catalogue Studies," and have ordered a new section for the case containing this collection, to accommodate its rapid growth. Pocket indexes to "Catalogue Studies" will be furnished to members on request.

The card catalogue of the library has outgrown its quarters in the old six-drawer cabinet, and a new cabinet, consisting of base, top and nine-drawer unit, to which sections may be added at any time, has been purchased. A new sign has also been provided for the Clemens Herschel Library.

Respectfully submitted,

S. EVERETT TINKHAM,
FREDERIC I. WINSLOW,
Library Committee.

REPORT OF THE EXECUTIVE COMMITTEE OF THE SANITARY SECTION.

BOSTON, MASS., March 5, 1919.

To the Boston Society of Civil Engineers :

The Sanitary Section has held four meetings and two excursions, during the year, as follows:

March 6, 1918. — Excursion to L Street power plant of the Edison Electric Illuminating Company. Attended by thirty members.

March 6. — Annual meeting. After the annual business was disposed of, a paper on "Economy in the Use of Fuel in Power Stations" was read by Charles H. Parker, superintendent of the Generating Department of the Edison Company of Boston. Fifty-three members and guests were present.

May 1. — Special meeting. Illustrated lecture on "Health Education in China," by W. W. Peters, of Shanghai, China. Forty-one present.

June 5. — Excursion to Worcester Sewage Purification Works. Attended by forty-three members and guests.

November 15. — Postponed regular meeting. Subject: "Spanish Influenza, Its Cause and Treatment," by Lieutenant-Colonel Brooks, Major Harrington and Lieutenant Mathes. Twenty-five members and guests were present.

December 4. — Regular meeting. Subject: "Sanitation of the Emergency Shipyards," by W. L. Stevenson, sanitary engineer. Twenty-nine members and guests were present.

Previous to the meeting of December 4, twenty-three members and guests dined at the Engineers' Club.

A small attendance to the above meetings was due to the fact that a large proportion of our membership was absent on war work. Other meetings were arranged for, during the fall, but, on account of the influenza epidemic, could not be held.

No January meeting was held, owing to the fact that the paper by Mr. Dorr and Mr. Weston, although on a strictly sanitary engineering subject, was read before the main Society. All the papers presented at the above meetings have been published in the Society JOURNAL.

None of the committees have been able to do any work on the subjects assigned to them, on account of their being engaged in war matters.

Two new members were enrolled during the year, so that the total membership is now 174.

Respectfully submitted,

EXECUTIVE COMMITTEE,
HENRY A. VARNEY, *Clerk.*

REPORT OF THE COMMITTEE ON SOCIAL ACTIVITIES.

BOSTON, MASS., March 11, 1919.

To the Boston Society of Civil Engineers :

There have been two excursions during the past year included in the activities of the Society, and this committee has assisted in the details necessary for the success of these excursions.

The field day and excursion of the New England Water Works Association and the Boston Society of Civil Engineers was held at Pemberton, June 19, 1918. Members and guests assembled at Rowes Wharf, where the boat was taken for Pemberton at 10.15. The program included a ball game between the members of the two societies, dinner at Pemberton Inn and an entertainment during the dinner followed by an address by Major Marlatt, of the 4th Canadian Mounted Rifles. The ball game was won by the New England Water Works Association, the score being 7 to 1. There were 114 members and guests at the dinner, many ladies being among the guests.

Through the courtesy of Major Charles R. Gow, constructing quartermaster, U. S. A., and Mr. Frank W. Hodgdon, chief engineer, Waterways and Public Lands Commission, there was an excursion to the United States Army Supply Base and to the Commonwealth Dry Dock, December 18, 1918. The party was conducted by guides through the grounds and buildings of the Army Supply Base and also through the Dry Dock, and had the opportunity to see everything of interest. Through the courtesy of Mr. James W. Rollins, inspection of the work from tug boats was included in the program. Mr. W. F. Kearns, of W. F. Kearns Company, engineers and contractors, associate member of the Society, very generously extended an invitation to the company for refreshments which were served at the conclusion of the excursion. The attendance at this excursion was about 325.

Respectfully submitted,

David A. Ambrose,
Chairman Committee on Social Activities.

Progress Report of Committee on Run-Off.

Boston, March 19, 1919.

To the Boston Society of Civil Engineers :

The Boston Society of Civil Engineers Committee on Run-Off, appointed December 20, 1916, made a report to the Society which was published in the Journal for April, 1918, and a further report which was published in the Journal for November, 1918.

The purpose of the report of November, 1918, was to put into the hands of members of the Society and others interested, for their information, a number of chapters on topics which have already been discussed to some extent by members of the committee; and which, after more thorough discussion, it is proposed to incorporate in the final report of the committee, to be made at a later date.

These chapters are as follows:

Glossary of Terms.
The Use of the Current Meter in Stream-Gaging.
0.2 and 0.8 Method of Current-Meter Measurement in Power Canals.
Precipitation, Evaporation and Run-off.
The Effects of Ice on River Discharge.
Methods to be Used in Compilation of Data. Analysis of Run-off Records.

Copies were sent to engineers particularly interested in hydraulic matters, with the following letter:

"*Dear Sir :*

"A Progress Report of the Committee on Run-off of the Boston Society of Civil Engineers is being sent you with the hope that you will find the time and interest to examine it carefully and give the committee the benefit of any suggestions or criticisms you wish to make.

"The purpose of this committee is to collect, compile, analyze and report on the best figures of run-off, in New England, which are available for water-power purposes. It is the intention of the committee, before reporting any records, to carefully examine both published and unpublished records of stream-flow, and to study these records along the lines indicated in this progress report, and others which will appear later in the JOURNAL.

" Any assistance or contribution either as to the accuracy of New England records or the importance of the methods discussed by the committee will be very much appreciated and of great assistance in making the final report of the committee valuable to engineers and others.

" An early reply is essential to the committee.

" Very truly yours."

Replies have been received from a number of engineers, full of helpful suggestions, which the committee are now discussing. The list of engineers contributing to the discussion is as follows:

Paul L. Bean, chief engineer, Public Utilities Commission, Augusta, Me.
Clinton Bogert, Room 2200, Municipal Building, New York.
C. E. Chandler, Chandler & Palmer, 161 Main Street, Norwich, Conn.
*John R. Freeman, Grosvenor Building, Providence, R. I.
Clemens Herschel, No. 2 Wall Street, New York, N. Y.
Robert E. Horton, construction hydraulic engineer, 57 North Pine Avenue, Albany, N. Y.
Ivan E. Houk, The Miami Conservancy District, Dayton, Ohio.
*Chas. T. Main, engineer, 201 Devonshire Street, Boston, Mass.
*I. W. McConnell, American International Shipbuilding Corporation, Hog Island, Pa.
F. H. Newell, professor of civil engineering, University of Illinois, Urbana, Ill.
C. M. Saville, Board of Water Commissioners, Engineering Department, Hartford, Conn.
Frederic P. Stearns, civil engineer, 1 Ashburton Place, Boston, Mass.
Arthur E. Winslow, professor of civil engineering, Norwich University, Northfield, Vt.
C. O. Wister, 57 North Pine Avenue, Albany, N. Y.

It is recommended that the committee be given time enough by the Society to complete its work and make the final report something of real value to the subject of run-off of streams in New England.

ARTHUR T. SAFFORD, *Chairman*,
CHARLES H. PIERCE, *Secretary*,
HAROLD S. BOARDMAN, *Vice-Chairman*,
A. C. EATON,
X. HENRY GOODNOUGH,
RICHARD A. HALE,
CHARLES W. SHERMAN,
HERBERT A. MOODY,
W. FRANK UHL,
JOSEPH F. WILBER,
DANA M. WOOD,
Committee on Run-Off.

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*Acknowledged receipt of letter and report but offered no comments.

REPORT OF THE EDITOR.

TO THE BOARD OF GOVERNMENT OF THE BOSTON SOCIETY OF CIVIL ENGINEERS:

Gentlemen, — The Editor submits the following report for the year 1918.

During the year 20 papers and 4 memoirs of deceased members have been published in the JOURNAL. The customary 10 issues of 1 250 copies, each, have been printed. The total number of pages used was 735 and the net cost $2 367.75, or $3.22 per page, a considerable increase over the corresponding cost in 1917.

On account of war conditions the year has been a difficult one in many ways. Engineers have been largely engaged in war-time activities, and have had neither the time nor inclination to prepare papers for publication, with the result that it has often been necessary to assemble material hurriedly and send it to the printer without suitable preparation or editing.

The tremendous pressure under which industries have operated and which can hardly be realized except by those actually engaged in industrial enterprises, has made it, at times, impossible to publish the JOURNAL with promptness, even after the material was in the hands of the printer.

Difficulties commenced with the " heatless Monday " order of the Fuel Administrator, of last January, and constantly increased as the draft and other war work drew increasing numbers of men from the printer's forces.

Financially, the almost universal cutting of advertising appropriations by corporations has resulted in some loss of revenue. It is needless to say that attempts to acquire new advertisements during this period have been most discouraging.

The net loss of advertising space, however, amounting to one page, is less than might have been expected under the circumstances.

It is also encouraging to note that several firms who discontinued their advertisements and who have been interviewed on the matter have expressed their intentions to renew their contracts at an early date.

The appended table gives in detail figures of cost, number of pages printed, etc.

Respectfully submitted,

W. L. BUTCHER, *Editor.*

1918 JOURNAL.

Month.	PAGES OF				NO. OF		COST OF							
	Papers.	Proc.	Index.	Adv.	Inserts.	Cuts.	Papers, Proc. and Index.	Cuts.	Advts.	Reprints.	Postage, Wrapping and Mailing.	Editing.	Incidentals.	Copyright.
Jan.	52	9		16½		23	$236.28	$39.84	$21.93	$28.25	$16.68			$10.00
Feb.	52	10		16½		9‡	217.18	8.84	19.65	18.50	15.91			
Mar.	38	11		15½		15‡	186.43	24.75	15.88	15.50	16.26		$1.32	
Apr.	50	32		15⅓		10‡	288.51		18.85	27.75	16.53			
May	36	11		15⅓		10‡	177.04	28.41	15.10	18.20	15.60		0.66	
June	92	9		15¼		23‡	357.46	10.70	15.80	42.50	13.43			
Sept.	46	12		14⅓		3‡	220.56		17.45	21.25	16.46		0.06	
Oct.	20	5		14⅓	4	13	116.86	124.94	16.55	15.00	18.29		43.29†	
Nov.	36	5		14⅓	3	2	179.27	111.13	17.80	25.00	18.70			
Dec.	26	9	10	15½		4	169.99	15.47	21.70	14.75	18.57		0.12	
Total	448	113	10	153+*	7	112	$2 149.58	$364.08	$180.71	$226.70	$166.43	$450.00	$45.45	$10.00

Total gross cost		$3 592.95
Subscriptions	$54.00	
Sale of JOURNALS	31.20	
Sale of reprints	19.50	
Advertisements	1 120.50	
		1 225.20
Net cost		$2 367.75

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* 164 pages used, not set solid.

† Includes 10 000 wrappers, $43.00.

‡ Some cuts furnished without expense to the Society.

APPLICATIONS FOR MEMBERSHIP.

[April 15, 1919.]

The By-Laws provide that the Board of Government shall consider applications for membership with reference to the eligibility of each candidate for admission and shall determine the proper grade of membership to which he is entitled.

The Board must depend largely upon the members of the Society for the information which will enable it to arrive at a just conclusion. Every member is therefore urged to communicate promptly any facts in relation to the personal character or professional reputation and experience of the candidates which will assist the Board in its consideration. Communications relating to applicants are considered by the Board as strictly confidential.

The fact that applicants give the names of certain members as reference does not necessarily mean that such members endorse the candidate.

The Board of Government will not consider applications until the expiration of twenty (20) days from the date given.

Cashman, James Eugene, Burlington, Vt. (Age 43, b. Quincy, Mass.) Graduate of Quincy High School, 1894, and student at Boston Night School of Designing and Drafting. Has had twenty-five years' experience in construction of fortifications, breakwaters, roads and buildings; was for five years general manager and treasurer of Bay State Dredging & Contracting Co., during which time the company was contractor for Bellevue Hill water tower, Metropolitan Park boulevard at Quincy, high-level sewer at Needham, and numerous other jobs of importance, including dredging in connection with Boston Army Supply Base; is now general contractor and engineer and treasurer of Bay State Dredging & Contracting Co.; is member of Vermont Society of Engineers. Refers to C. B. Breed, W. H. Ellis, Jr., T. T. H. Harwood, C. T. Main, F. D. Smith and B. T. Wheeler.

Rankin, Elmer Paull, Boston, Mass. (Age 22, b. New Bedford, Mass.) Educated in public schools, at Franklin Union (evening courses, 1915–16), and at Lowell Inst. School for Industrial Foremen, 1916–18. From May, 1914, to November, 1915, draftsman and field inspector with W. S. Johnson, C. E.; from September, 1917, to April, 1918, structural draftsman with Stone & Webster; from April, 1918, to date, structural draftsman and designer with Fay, Spofford & Thorndike. Refers to C. R. Berry, C. A. Farwell, J. S. Lamson and H. C. Thomas.

ROLL OF HONOR.*

ADDITIONS.

DEPUY, CLARENCE S. Captain, Q. M. C., Const'n Div., U.S.A., Room 1–234, Washington, D. C.

REVISIONS.

DURHAM, HENRY WELLES. Major, Engineers, U.S.A., Dept. of Const'n and Forestry, Tours, France, Am. Ex. Force.

ENEBUSKE, CARL C. Master Gunner, office of Chief of Artillery, First Army, Am. Ex. Force, France.

HARRIS, GILBERT M. Private, care Div. Engr. Office, 1st Replacement Depot, St. Aignan-Noyens, Am. Ex. Force, France, A. P. O. 727.

HARTY, JOHN J. Captain, Ordnance Dept., U.S.A., Base Ordnance Depot No. 4, Base Section No. 2, A. P. O. 705, Am. Ex. Force.

HUBBARD, CARL P. Captain, Company C, 11th Engrs. (Ry.), Am. Ex. Force, France.

NEWMAN, ROLF R. Captain, Engineers, U.S.A., The Engineer School, Camp Humphreys, Va.

WORCESTER, ROBERT J. H. 1st Lieutenant, Company E, 117th Engrs., 42d Div., U.S.A., Am. Ex. Force, France.

LIST OF MEMBERS.

ADDITIONS.

REEDS, CLARENCE	8 Merrimack St., Lowell, Mass.
WILSON, HERBERT A.	6 Beacon St., Boston, Mass.

CHANGES OF ADDRESS.

BOAS, BENJAMIN	73 Hancock St., Dorchester, Mass.
BRESTH, ALEXANDER	Care Florida State Board of Health, Jacksonville, Fla.
EICHORN, FREDERICK C. H.	306 South St., Jamaica Plain, Mass.
FAIR, GORDON M.	Engineering School, Harvard Univ., Cambridge, Mass.
FARRELL, FRANCIS B.	86 St. James Ave., Boston, Mass.
GARVEY, JOHN C.,	Care Casper Ranger Const'n Co., 20 Bond St., Holyoke, Mass.
McCONNELL, IRA W.	61 Broadway, New York, N. Y.
PHILLIPS, LAURENCE J.	100 Boylston St., Room 1003, Boston, Mass.
TAYLOR, PHILIP W.,	Care Lockwood, Greene & Co., Yorkship Village, Camden, N. J.
WENTWORTH, JOHN P.	66 Sprague St., Malden, Mass.
WOOD, LEONARD P.	Care Franklin Tr. Co., 46 Wall St., New York, N. Y.
WRIGHT, EDWARD	Room 141, State House, Boston, Mass.

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* Members who are in the service and have not yet reported that fact to the Secretary are earnestly requested to do so, stating branch of service, rank and military address.

RESIGNATIONS.

(In effect March 19, 1919.)

ATWOOD, THOMAS C.
BONNET, FREDERIC, Jr.
BRUNEL, RICHARD.
FRENCH, HERMAN W.
HAKES, JESSE F.
JANES, CHARLES F.
JERRETT, ROBERT.
LANZA, GAETANO.
MOSES, ERNEST M.
ROBINSON, HAROLD L.

EMPLOYMENT BUREAU.

THE Board of Government maintains an employment bureau for the Society, to be a medium for securing positions for its members and applicants for membership, and also for furnishing employees to members and others desiring men capable of filling responsible positions.

At the Society rooms two lists are kept on file, one of *positions available* and the other of *men available*, giving in each case detailed information in relation thereto.

MEN AVAILABLE.

445. Age 47. Graduate of Dartmouth College, degree of B.S. Experience covers five years with Massachusetts Metropolitan Water Board on reservoir construction and seventeen years in responsible charge of important municipal work; recently discharged from U. S. Army, where he held rank of captain, Q.M.C., Construction Division, having been assigned as officer in charge of utilities at U. S. A. general hospital. Would be interested in engineering position dealing with water, sewers, streets or operation and maintenance of utilities. Salary desired, $3 000 per year.

450. Age 31. Graduate of Tufts College, 1911. Has had seven years' experience with manufacturers of electrical machinery and chemical apparatus; experience includes shop practice, testing, production, costs and inspection. Desires position as assistant to executive with manufacturing concern. Salary desired, $1 800 per year.

451. Age 35. Graduate of Copenhagen Univ., Denmark; student for one year at Columbia Univ. evening school and for four and one-half years at Cooper Union evening school, technical and engineering courses; passed examination for junior civil engr., Engineering Dept. at Large, Washington, D. C., 1915, and for expert aid, 1918. Has had wide experience along engineering lines, including two years as architectural draftsman and detailer in woodworking mill; eight and one-half years with engineering department of railroad, as rodman, inspector, chief of party and draftsman on variety of

work; eight months on railroad valuation work; nineteen months as engineer with firm of contractors, Pittsburgh, Pa.; and nine months as draftsman and progress engineer on Boston Army Supply Base. Desires permanent executive position. Minimum salary desired, $2 500 per year.

452. Age 38. Student for three and one-half years at Univ. of Michigan, civil engineering course. Has had seventeen years' experience, chiefly as superintendent or resident engineer on construction work. Desires position as resident engineer on location or construction work. Salary desired, $200 per month.

453. Age 41. Graduate of Mass. Inst. of Technology, degree of S.B. Has had seventeen years' experience in municipal work, especially water works and filtration; was captain with Construction Div., U.S.A., Water and Sewer Section. Desires position as manager or superintendent of water works.

LIBRARY NOTES.

BOOK REVIEW.

"AMERICAN ENGINEERS BEHIND THE BATTLE LINES IN FRANCE," by Robert K. Tomlin, Jr., war correspondent for the McGraw-Hill Publications. First edition. New York, McGraw-Hill Book Co., Inc. Cloth, 9 x 12 in., pp. 91, illustrated. $2.00.

REVIEWED BY LEWIS E. MOORE, MAJOR ENGRS., U.S.A.

Mr. Tomlin was a war correspondent for the *Engineering News Record* in France. This volume is the collection under one cover of the very interesting articles which he wrote and which were originally published at intervals in the *Engineering News Record*. They give an excellent résumé of the varied activities of the engineers who worked back of the lines in France, and are of considerable historical value as a record of achievement, even though it has been necessary to omit names both of persons and places. It naturally does not cover the activities of the so-called "pioneer" or combat engineer troops. The book is written in popular rather than technical style, and contains much of interest to both the engineer and the layman.

Recent Additions to the Library.

U. S. Government Reports.

Annual Report of Federal Board for Vocational Education for 1918.

Contributions to Economic Geology, 1917: Part II. — Mineral Fuels. David White.

Economic Limits to Domestic Independence in Minerals. George Otis Smith.

Effect of Grazing upon Aspen Reproduction. Arthur W. Sampson.

Estimates of Population of United States, 1910–1917.

Extinguishing and Preventing Oil and Gas Fires. C. P. Bowie.

Fuel Facts. 2d ed, 1918.

Geology of Northeastern Montana. Arthur J. Collier.

Gold, Silver, Copper, Lead and Zinc in Utah in 1916. V. C. Heikes.

Gold, Silver, Copper and Lead in South Dakota and Wyoming in 1917. Charles W. Henderson.

Inflammability of Aluminum Dust. Alan Leighton.

International Control of Minerals. C. K. Leith.

List of Publications of Federal Board for Vocational Education, February, 1919.

Method of Least Squares Applied to Estimating Errors in Coal Analysis. J. D. Davis and J. G. Fairchild.

Methods for Routine Work in Explosives Physical Laboratory of Bureau of Mines. S. P. Howell and J. E. Tiffany.

Mining and Milling of Lead and Zinc Ores in Missouri-Kansas-Oklahoma Zinc District. Clarence A. Wright.

Pulpwood Consumption and Wood-Pulp Production in 1917. Franklin H. Smith.

Private Forestry. Henry S. Graves.

Relation of Dehydration to Agriculture. Maj. S. C. Prescott.

Suggestions for Improved Methods of Mining Coal on Indian Lands in Oklahoma. J. J. Rutledge and Daniel Harrington.

Tin in 1916. Adolph Knopf.

Use of Wood for Fuel. Office of Forest Investigations.

State Reports.

Michigan. Annual Report of State Board of Health for 1917–18.

County Reports.

Essex County, Mass. Engineer's Report for 1918.

City and Town Reports.

Belmont, Mass. Annual Report of Water Commissioners for 1918.

Boston, Mass. Twenty-Fourth and Final Report of Transit Commission, for 1917–18.

Concord, Mass. Annual Report of Road Commissioners for 1918.

Detroit, Mich. Annual Report of Water Commissioners for 1917–18.

Detroit, Mich. Report on Grade Separation in Detroit, 1917–18.

Dover, N. H. Annual Report of Water Commissioners for 1918.

Newton, Mass. Annual Report of City Engineer for 1918.

Newton, Mass. Annual Report of Street Commissioner for 1918.

North Adams, Mass. Annual Reports of Officers for 1918.

Providence, R. I. Annual Report of Water Supply Board for 1918.

Rutland, Vt. Annual Report for 1918.

Miscellaneous.

Building of a Wooden Ship. Charles G. Davis. Edited by Thomas W. Clarke and Frank S. Drown. Gift of T. W. Clarke.

Canada, Department of Mines: Preliminary Report of Mineral Production of Canada during Calendar Year 1918. John McLeish.

Engineering Index Annual for 1918.

Fourth Dimension Simply Explained. Henry P. Manning.

Industries and the State under Socialism. Rome G. Brown.

(The) League of Nations. Woodrow Wilson and others.

(The) Lodge-Lowell Debate. Henry Cabot Lodge and A. Lawrence Lowell.

Plan for Railroad Reorganization. William G. Raymond.

Some Postal Economics. Charles Johnson Post and Jesse H. Neal.

Vacuum Oil Co.: Horizontal Gas Engines (Small and Medium); Horizontal Gas Engines (Large); Vertical Gas Engines; Stationary Steam Engines; Lubrication of Automobile: Part 1, The Engine; Part 2, The Chassis.

Yeomans Brothers Co.: Pumping Machinery.

LIBRARY COMMITTEE.

Vol. VI APRIL, 1919 No. 4

BOSTON SOCIETY OF CIVIL ENGINEERS
FOUNDED 1848

PAPERS AND DISCUSSIONS

This Society is not responsible for any statement made or opinion expressed in its publications

ADDRESS AT THE ANNUAL MEETING.

By Charles M. Spofford, President Boston Society of Civil Engineers.

(March 19, 1919.)

Reconstruction and the Engineer.

The officers' reports just presented show that in spite of war and pestilence our Society has prospered during the past year. At our meetings and for our publications we have received papers illustrating the ever-broadening scope of the engineers' activities. Our membership has decreased but slightly; our current funds have been enough to cover all expenses except the remission of dues for members in service, which has been met by the use of income from the permanent fund; our meetings have been well attended; we have put into operation for the first time the new method of electing officers adopted last year, a method the success of which may be confidently predicted from the high standing, professionally and otherwise, of those elected to office to-day.

Our members have played an important part in winning the war. Some have seen active service overseas; others have been foremost in formulating and executing the great engineering projects carried on by the Construction Division of the Army and by other Government departments, projects which by their magnitude and speed of construction gave overwhelming proof to our enemies that both in organization and deeds the free citizens of this country could accomplish more than the ponderous German war machine. Some of the war work of our members has already been set forth in our Transactions; it is hoped that during the coming year additional papers may be printed, to the end that our records may present in full the value of the service rendered to the country by our members.

It is not my intention, however, to consider the past; it is the problem of the future which should receive our attention as well as that of all other seriously minded persons. Never before has mankind had the opportunity that now lies before it. Our ancestors established here in America a new nation whose rulers received their authority neither by divine right nor by force of arms but by the free choice of their fellow-citizens, and we look upon it as one of the great forward steps of humanity. The thirteen American colonies had the same language and common aspirations, yet the task of welding them into a nation and keeping that nation intact as it grew was a mighty one. A deadly civil war was necessary to interpret its constitution; participation in the greatest of all wars has not entirely succeeded in fusing its discordant parts into a homogeneous mass.

We of this generation are, however, planning to establish a new world; to organize a federation of nations varying in tradition, in language, in religion; bearing the memories of deadly struggles with one another, of oppression one over the other, but united, we hope, in the determination that their leaders, whether emperors or presidents, shall no longer find it possible by means of secret alliances to force them into unjust wars in order to satisfy a thirst for power.

Whether or not we believe the present draft of a constitution for a league of nations is a proper one and properly preserves the nationality of our country, we all hope and believe that some formula will be found by the congress now meeting in Paris which will hereafter protect all civilized nations from the attack of predatory nations such as Germany.

The success of this new league will depend upon the knitting together of its distant members, both by land and by sea, more closely than ever before. The tendency to Bolshevism must be reduced by the greater development of natural resources; deserts such as Mesopotamia must again be made fertile by irrigation;

the mineral and agricultural wealth of Russia, China and Siberia must be put at the command of the world. All of these problems require the services of the engineer for their solution, and, as in the new federation, the United States, with its great resources affected but little by the war, and now a creditor instead of a debtor nation, will be foremost, so its engineers are sure to be called upon to take a more active part in the development of the world than ever before.

To fill this rôle successfully, the American engineer must, however, show himself to have breadth of view; must not permit himself to be lost in engineering detail; must appreciate more than ever before that it is *the man behind the engineer that counts;* that engineering training is merely a tool which of itself is of little value; that for its efficient use character, judgment, vision, courage, energy, resourcefulness, knowledge of men and ability to carry responsibility are all essential. Lacking these qualities, no engineer will attain leadership in the affairs of the greater world. The engineer who does not possess them naturally, or attain them by experience and study, may achieve some success, but the rewards of leadership will not be his. He will continue to follow others; to be under the control of men with broader views and larger interests; to be a servant instead of a commander.

The technical schools — some of them, at least — recognize that the education of the engineer should, in the future, lay more emphasis on the training of the man along lines which will develop the qualities just enumerated than upon the purely professional studies, and we engineers in practice would do well to impress the same view upon the younger engineers with whom we are associated, to encourage them to familiarize themselves with foreign affairs and with economic and social questions, not to be afraid to search for and accept new opportunities and responsibilities, to the end of self-development and progress.

But what about the more immediate future in our own country? Never before, apparently, has our country stood in greater need of men with engineering training, accustomed to base conclusions upon proven facts, not upon passing emotions; to predict results, not from guesses but from established laws.

The unprecedented financial obligations assumed by the country; the reduction in its man-power by emigration; the higher wages which labor has won, and which, while they will undoubtedly drop, will probably never reach the low figure we were accustomed to before the war, — all demand economies and efficiencies never before required, to secure which trained men, intelligent administrators and planners, will be more needed than ever. Ill-conceived and poorly operated enterprises will have greater difficulties in existing; the engineer will have a greater chance than ever. Moreover, our natural resources will have to be developed; water-power will be utilized as never before; to economize in coal great central power plants will be constructed at the seaboard and at the coal fields; hydraulic-power plants will be linked together; foreign commerce will be carried by American ships, and our ports, rivers and inland waterways will be improved.

In spite of the impending prosperity of the future, the present period of stabilization and readjustment may prove a trying one. What can we as individuals, and as an organization, do to take advantage to the utmost of the public recognition of the importance of engineering made manifest by the war and now reflected by the large influx of students at technical schools? To accomplish this, the individual engineer may well play his part in promoting public and private improvements. It is to him that the expenditure of large sums must be intrusted in case such work is carried out, and he should now display his foresight and skill in planning projects of public benefit in order not only that labor may find employment and be content, but also that public needs may be anticipated and economies thereby secured even at high rates for wages and materials. He should also be willing to serve the public when called upon, in unpaid positions if necessary, in order that public construction projects may receive expert criticism in advance of construction, and public funds be thereby conserved.

For the engineering societies I would suggest two things.

First, the carrying on of a campaign of education in papers and popular magazines in order to inform the public what the engineer's duties are and why he should be employed. The public — at least the more intelligent public — should be made to realize that the civil engineer is not merely a surveyor; that mechanical engineers are not enginemen; that electrical engineers are not linemen. The cost of such a campaign might be great; its value, I believe, would be greater. Such instances as failures of bridges, dams and molasses tanks should be used to point out the economic loss resulting from the failure of owners to secure the advice of competent engineers upon the design of important structures and of paying them fees commensurate with the skill required.

Secondly, I believe that the societies should urge the regulation of engineers, either by the state or by the engineering societies themselves. In this state, no doctor can practice without registration, nor without holding a diploma from a school authorized by law to grant a medical degree. No lawyer can be admitted to practice at the bar without the sanction of the courts — also a matter of state regulation.

Is it less important for the public welfare that men should be allowed to design and construct structures, on the safety of which sometimes depends the lives not only of individuals but also of whole communities, without proving to a competent board their ability and skill? In my judgment, such regulations would aid the engineering profession as a whole and give it a higher standing in the community, even though it is true that if adopted many now calling themselves engineers might have to content themselves in the future with a less pretentious title until passing the requirements laid down by the board of examiners; this should, however, encourage self-improvement, and thus be a service rather than a detriment to the individual.

In considering in what further manner the engineering societies may improve the standing of their members in the community we must not ignore a recent movement which is sure to have the opposite effect; viz., the establishment of new engineering societies which are affiliating themselves with labor unions. It is said that such organizations have been stimulated by the belief that the older national and local engineering societies — such, for example, as our own society — are controlled by engineers who, for the larger part, are employers and therefore not interested in obtaining increased compensation for the younger men. This feeling I believe to be entirely unjustified, and I am sure I speak for the individual members of this Society when I say that we are anxious to raise the scale of compensation for all engineers, both young and old. The method to be adopted is, however, not obvious. The engineering societies were not formed for the mere purpose of raising the compensation of their members, but rather in order that members might benefit by the experience of others as presented in papers, and by acquaintance with one another made through the medium of regular meetings, thereby increasing their ability to serve their clients and the community and thus increasing their value and incidentally their compensation.

On the other hand, a principal object of the labor unions has been to increase wages without increasing the value of the service rendered. It is, however, an interesting fact that the labor unions in Boston are now planning to establish educational courses for their members, thereby adopting to a certain degree the policy of the professional societies.

Is it not possible that the engineering societies might well take action looking towards the setting up of minimum standards of compensation for their members by means of voluntary agreements?

This is a question which I believe should receive the serious consideration of the members of this Society.

And now, in closing, let me express my appreciation of the honor done me by the Society in permitting me to serve as its president during the last year, and to extend to our new President and his associates my heartiest best wishes for a successful year.

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BOSTON SOCIETY OF CIVIL ENGINEERS
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PAPERS AND DISCUSSIONS

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THE DISPOSAL OF SEWAGE BY TREATMENT WITH ACID.

By Edgar S. Dorr* and Robert Spurr Weston,† Members of the Boston Society of Civil Engineers.

(Presented January 22, 1919.)

Introduction.

In the sewage disposal realm, several ideas struggle for mastery: first, that of the economist, now many years old, that the enormous loss of fats and fertilizer caused by the discharge of human wastes into our rivers and oceans should be prevented; second, that of the sanitarian, that human excrement should not endanger human life; third, that of the lover of beauty, that nuisance and unpleasantness should be avoided; fourth, that of the engineer, that the ends of health and beauty should be obtained efficiently and economically; and fifth, that of the citizen, that he should not pay an excessive price for benefits received.

The enormous values of the products wasted with sewage have allured many engineers to attempt to recover them, as the hundreds of descriptions of patents, processes and plants, in the scientific literature of the past twenty-five years, testify.

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Note. — Discussion of this paper is invited, to be received by W. L. Butcher, Editor, 715 Tremont Temple, Boston, before June 10, 1919, for publication in a subsequent number of the Journal.

Quite recently Dr. Samuel Rideal* has estimated that, from the camps in England, 40 000 lbs. of fat might be recovered daily, and from the rest of the population, 400 000 lbs. daily. Dr. Rideal also states that the pressed and dried sludge from the Dresden sewage contained 13.4 per cent. of fat, which was extracted by ethylene chloride. It has been reported that during the war many other German cities have used sewage as a source for fats; also that the city of Stockholm, Sweden, has done the same. Although these were war-time measures, the possibility of recovering the 7 300 tons of fats and the 27 000 tons of fertilizer discharged annually with the Moon Island sewage is alluring as a peace-time practice.

What has been the result in normal times of the many attempts to recover valuable products from sewage? The Chinese and others have made use of human excrement for fertilizer, and evidences of the practice are carried away in the nostrils of travelers from the Far East; but so far there are only two methods of disposal for water-borne wastes which have shown a real profit in practice, namely, farming with sewage irrigation in arid districts, and the acid process when applied to wool-scouring waste or to sewage consisting largely of wool-scouring waste, as at Bradford, England. During the war the profits of the Bradford plant were very large.

Sludge Treatment.

While so far the efforts to recover fat and fertilizer from ordinary aqueous sewage have not proved profitable, several noteworthy attempts have been made to recover valuable by-products from the sludge from plain subsiding basins. At Cassel, Germany, sludge so produced was heated to boiling, acidified, filter-pressed, dried, and the grease then extracted from the dried mass with benzine. The extracted grease was then distilled with superheated steam. This plant failed to pay the cost of operation, notwithstanding the fact that the dried sludge contained 18 per cent. of grease, and the wet sludge produced 10 per cent. of cake, having a fertilizer value of 32.5 cents per 100 lbs. in addition to its grease value. (The distilled grease sold for $4.87, and the tarry residue left behind in the still for 41 cents per hundred pounds. The yield of the refined geease was 60 per cent. of the crude.*)

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* Rideal, S., 1916. Recovery of Fats and Nitrogen from Sewage. Proceedings, Association of Managers of Sewage Disposal Works, *59*, 571.

Experiments were conducted at the city of Frankfurt† to determine the feasibility of recovering the values contained in sludge. They are of chief interest in connection with this article in showing that the sludge when acidified with sulphuric acid yielded three times as much grease as the unacidified sludge.

In Wolverhampton, England, a process has been adopted based upon experiments of Dr. J. Grossman, of Oldham, England. The process was patented in 1908.‡ The sludge is partially dehydrated by adding 0.3 per cent. by weight of sulphuric acid to the sludge precipitated in the subsiding basins. After treatment with acid, the clear liquid is drawn off from beneath the scum, leaving a concentrated sludge, said to contain 75 per cent. moisture. This acidified and concentrated sludge is distilled with superheated steam in an externally fired, cylindrical still containing a hollow agitator with perforated radial arms through which superheated steam is passed. The process is reported profitable.

In addition to the above, many attempts have been made to utilize the sludge from chemical precipitation plants, using lime and ferrous sulphate as precipitants, but so far they have been unprofitable.

In recent years engineers have turned very generally to the biological processes of sewerage purification, chiefly to the method of disposal by bacteriological oxidation. In doing so, they have planned their works to oxidize the organic matter contained in sewage and to reduce the sludge by digestion. The plan has been considered most successful which produced most economically the highest degree of oxidation, or, as often expressed, the highest degree of nitrification, also the least and the least offensive sludge. The plant which best embodies these ideas comprises an Imhoff tank and a bacterial filter bed.

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* Hopfner and Paulmann, 1902. Die Verarbeitung der Rückstande aus der Schmutzwasser Reiningungsanlage der Stadt Cassel. Mit. a. d. König. Prüfungsanstalt f. Wasser. und Abwasser, *1*, 146.

† Bechold, 1899. Untersuchungen an dem Klärbeckenschlamm zu Frankfurt a. M. Zeitschrift für angewandte Chemie. *12*, 849.

‡ English Pat., 16, 397, August 4, 1908.

With one exception, no by-products of any considerable value can be recovered to offset the cost of treatment by oxidation. The one exception is the activated sludge process. This is a combination of a physical and a biological process, in which part of the organic matter is destroyed and a very complete separation of the suspended and liquid portions of the sewage is brought about. The process has the further advantage of producing an effluent of good appearance and low bacterial content, which can be discharged into many bodies of water with impunity. This feature and that of easy sludge separation have stimulated engineers to recover the fat and fertilizer values which exist in the bulky activated sludge. It is claimed by many that products of enough value can be recovered to gain a small profit over and above the cost of handling the sludge, but this value will not entirely offset the cost of the whole process. However, it will probably outweigh the cost of sludge disposal. The whole process marks a notable advance. It may be regarded as the climax of the biological processes, and if the net cost, including the cost of aëration and recovery of valuable products, may be brought within reasonable limits, the process may be applied in many cases where the conditions are favorable. It is not applicable to sewages containing those manufacturing wastes which retard bacteriological action.

The activated sludge process, and one other process to be described shortly, have served to re-stimulate interest in the possibility of recovering enough valuable products to make their values important factors in the economy of sewage disposal processes. That other is a new chemical precipitation process known as the Miles acid process, and to describe it and to indicate its possibilities is the object of this paper.

THE MILES ACID PROCESS.

History.

Beginning about the year 1900, Mr. George W. Miles, a well-known Boston chemist, with the coöperation of the officers of the Boston Sewer Department, suggested the use of acid to accelerate the precipitation and separation of sludge, and proposed to recover fats and fertilizer from the sludge so produced. The most important factor in the new process consists in the application of the acid to the sewage itself, rather than to the sludge precipitated therefrom; and it lays emphasis upon the decomposition of the soluble soaps and the liberation of the fatty acids,* which latter do not appear as fats when unacidified sewage is tested by standard methods, and are only partially precipitated with the sludge in plain subsiding basins. Furthermore, Miles has suggested the use of sulphur-dioxide gas rather than the sulphuric acid† made from it, thereby avoiding several expensive steps in its manufacture and greatly reducing the cost, besides bringing into play the disinfecting action of the sulphur-dioxide gas upon the sewage itself. If desired, a combination of sulphuric and sulphurous acids may be used.

Sodium acid sulphate (niter cake) is the waste product from the nitric-acid plants, and, as a result of the war, there are enormous quantities of this material piled near nitric-acid plants, for which there is now little use. At the present time this is the cheapest source of sulphuric acid. Before the war, the cheapest source was either sulphur or pyrite (ferrous sulphide).

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* Most fats are combinations of glycerine with fatty acids. Soaps are combinations of fatty acids with sodium or potassium. Soaps are soluble, and if a sewage containing them be evaporated, and the residue extracted with ether (the ordinary method of obtaining the fats), the fatty acids in the soaps are not dissolved. On the other hand, if acids be added, they decompose the soaps, set free the fatty acids, and then, if the sewage be evaporated or extracted with ether or another solvent, the fatty acid is dissolved with the true fats. The fatty acids recovered by the extraction of the sludge from acid-treated sewage, may be remade into soaps by treatment with soda or potash.

† Theoretically, sulphuric acid is oxidized sulphur plus water, that is:

$S+O = SO_2$ (Sulphur Dioxide)
$SO_2+H_2O = H_2SO_3$ (Sulphurous Acid)
$H_2SO_3+O = H_2SO_4$ (Sulphuric Acid)

Sulphurous acid is more effective than sulphuric acid for treating sewage. Furthermore, its use avoids the cost of oxidizing the sulphur dioxide. This is ordinarily accomplished by the use of nitric acid and the oxides of nitrogen in what is called a "lead chamber," into which nitrogen trioxide (N_2O_3), steam and air are introduced with the sulphur dioxide. The more modern way is to produce oxidization by direct contact of sulphur dioxide, oxygen and water with spongy platinum or some other catalytic agent, activated by electricity. From either the old or the new process dilute sulphuric acid results, and the cost of concentration as well as the cost of transporting the water, which is a necessary part of the finished product, ordinarily enter into the cost of sulphuric acid. It must, therefore, be added to the cost of sewage treated when sulphuric rather than sulphurous acid is used.

Experiments.

Experiments conducted by one of us (E. S. D.), and by other officers of the Sewer Division of the city of Boston, were made at different times between June 20, 1911, and June 29, 1914. In all, eleven runs were made at different times during the four years, and 25 986 gals. of sewage were treated. The quantities of products recovered per million gallons of Boston sewage, during these experiments, were, as averaged, 1 738 lbs. of dry sludge, containing 21.7 per cent. or 436 lbs. of grease, and 1 361 lbs. of fertilizer base, having an ammonia content of 4.5 per cent.

Early in 1915, one of us (E. S. D.) delivered a lecture before the students in the Public Health Department of the Massachusetts Institute of Technology, on the possibilities of the Miles process. The subject, as presented, greatly interested Prof. William T. Sedgwick, who later arranged with Mayor Curley for a large-scale experiment at the joint expense of the city of Boston and the Sanitary Research Laboratory of the Institute.

In the Technology experiments two continuous runs were made, one of seven days in July, and one of three days in November, 1915; and the volume of sewage treated averaged 8 241 gals. daily. The experiments are described elsewhere,* but the results obtained during the city's experiments were almost duplicated, as the following table shows:

During the summer of 1914, Mr. Langdon Pearse, division engineer of the sanitary district of Chicago, made experiments† to learn whether acidification could increase the yield of fat from the Center Avenue sewage. Tests in barrels and in a tank holding about 1 500 gallons were made under his direction. A three-hour period of subsidence was used, and the alkaline sewage required about 3 200 lbs. of 100 per cent. H_2SO_4 per million gallons. Sulphur dioxide was not tried.

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* Weston, R. S., 1916. Tests of a New Process of Sewage Purification, with Grease Recovery and Apparent Profit. American Journal of Public Health, *6*, 334. Reprinted in Boston City Record, March 3, 1917.

† Sanitary District of Chicago, Report on Industrial Wastes, 1914, pp. 191–194.

Pearse's results showed that acid treatment produced a higher recovery of fat, namely 69 per cent. of that in the sewage as compared with 47 per cent. obtained by plain subsidence for three hours. The sludge, which amounted to 2 275 lbs. per million gallons, contained, on an average, 93 per cent. of moisture and 25 per cent. of fats. The results also showed a great reduction in oxygen demand,— 170 per cent. of that obtained by an Emscher tank. They also showed a removal of 71 per cent. of the suspended matter.

TABLE 1.

Comparison of Average Results of Treating Sewage with Sulphurous Acid, as Shown in Experiments by E. S. Dorr and M. I. T. Sanitary Research Laboratory, 1912–1914 and 1915, Respectively.

	Experiments by E. S. Dorr.	Experiments by M. I. T. Sanitary Research Laboratory.
Average daily flow of sewage during experiments, gallons	92 514 647	103 498 049
Average amount of dry sludge, pounds per million gallons of sewage	1 738	1 909
Average percentage of grease in dry sludge	21.7	22.66
Average amount of grease precipitated from sewage, pounds per million gallons	436	430.1
Average amount of sulphur dioxide used, in pounds per million gallons	*2 300	1 963

Much more extensive experiments have been conducted by Prof. C.-E. A. Winslow of the Yale University Medical School, and Dr. F. W. Mohlman, now chemist of the Connecticut State Department of Health. The results of these experiments have been embodied in a paper read in September, 1918, before the American Society for Municipal Improvements at its meeting in Buffalo and abstracted elsewhere.†

The experiments were conducted at New Haven under the auspices of a special committee, and consisted of four long-time runs with the sewage from the East Street sewer, and one run

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* Approximate.

† *Engineering News-Record*, *81*, 1034–1036. Also *82*, 32–36.

with that from the Boulevard sewer, the former runs varying from twenty-four to seventy days, the latter being twenty-nine days' duration. Alongside the experiments with the Miles acid process, there were conducted experiments with screens, with the activated sludge process, and with Imhoff tanks and with plain subsiding basins, with and without chlorine disinfection.

In the experiments with the Miles process, the sewage was acidified with sulphur-dioxide gas, and a four-hour period of subsidence was provided. The alkalinity of the East Street sewage was very low, so that it was necessary, to secure an excess acidity of 50 p.p.m., to add only 700 lbs. of gas per million gallons of sewage treated. With the Boulevard sewage, 1 130 lbs. of acid per million gallons of sewage were required to secure the same excess acidity (computed in terms of calcium carbonate).

TABLE 2.

Character of Miles Acid Sludge at New Haven.

	East Street Sewer.				Boulevard Sewer.
Length of run	25 days	24 days	44 days	70 days	29 days
Total gallons sewage treated	260 000	239 400	407 820	602 220	145 500
Pounds of wet sludge per mil. gals. sewage	3 750	4 025	3 200	2 600	5 375
Specific gravity	1 067	1 048	1 054	1 061	....
Per cent. moisture	86.6	88	86.3	85.7	92.5
Pounds dry sludge per mil. gals. sewage	503	483	439	368	403
Ether extract, per cent. dry sludge	23.7	24.0	29	32.6	30.9
Ether extract, pounds per mil. gals.	119	116	127	120	124
Volatile matter, per cent. dry sludge	47.2	51.2	57.3	63.8	78.5
Nitrogen, per cent. dry sludge	1.6	1.6	2.4	2.0	3.0

The treatment removed from 61 per cent. to 66 per cent. of the total suspended, and 90 per cent. of the settleable solids. The removal of bacteria was all that could be desired, the two last experiments, with the East Street and Boulevard sewages respectively, indicating removals of over 99 per cent. of the total bacteria, and of the gas-forming organisms.

The use of acid accelerated the precipitation of the suspended solids by about 50 per cent., only 40 per cent. being removed from the untreated sewage by plain subsidence as compared with 60 per cent. when the Miles process was used. The data regarding the production of sludge are as follows:

Opposed to these very favorable results is the presence in the grease extracted from the sludge of a large proportion of unsaponifiable material (waxes, mineral oils and similar substances). Substances of this kind are practically worthless, and their removal is attended with a great deal of expense. The sludge from the East Street sewers contained 24 per cent. of grease, 46 per cent. of tankage and 28 per cent. of water. The grease had the following composition:

	Per Cent.
Moisture and volatile matter	11.0
Unsaponifiable material	21.1
Free fatty acids	40.2
Neutral grease	22.3
Insoluble soaps	3.3
Per cent. of resin in free fatty acids	14.4

The degreased sludge had the following composition:

Ammonia	3.91 per cent.
Phosphoric acid, P_2O_5	0.96 per cent.

Winslow and Mohlman are advised by experienced users of grease that it would be necessary to distill the crude extracted product in order to produce a salable grease. This fact has been recognized, and, on the basis of distillation experiments, they estimate that the grease in the East Street sewage would be worth $5.00, and the fertilizer $2.09 per million gallons, — a total of $7.09, net, — while the grease value of the Boulevard sewage would be $8.50, and the fertilizer value $2.88 per million gallons,— a total of $11.38, net.

Conditions at New Haven are such that the effluent must be clarified and disinfected, but not necessarily nitrified. These conditions are favorable to the Miles process, to Imhoff tanks combined with chlorination, and to fine screening combined with chlorination, respectively. The activated sludge process would not work because of the presence of copper salts in the sewage.

The operation costs of the disposal plant are estimated in the following tables:

TABLE 3.

ESTIMATED COST OF TREATMENT OF EAST STREET SEWAGE.
DOLLARS PER MILLION GALLONS.

	Miles Acid Process.	Imhoff Tanks and Chlorination.	Fine Screens and Chlorination.
Tanks and buildings (interest and depreciation)	$2.47	$5.28	$4.60
Acid treatment	6.93		
Drying sludge	2.09		
Degreasing sludge	1.78		
Redrying sludge	.17		
Superintendence	1.06	.46	.46
Labor on tanks and screens	1.00	1.20	1.42
Disposal of sludge or screenings		1.00	.50
Chlorination		4.05	4.05
Gross cost	15.50	11.99	11.03
Revenue	6.57		
Net cost	8.93	11.99	11.03

TABLE 4.

ESTIMATED COST OF TREATMENT OF BOULEVARD SEWAGE.
DOLLARS PER MILLION GALLONS.

	Miles Acid Process.	Imhoff Tanks and Chlorination.	Fine Screening and Chlorination.
Tanks and buildings (interest and depreciation)	$2.47	$4.44	$4.60
Acid treatment	10.74		
Drying sludge	2.04		
Degreasing sludge	1.91		
Redrying tankage	.17		
Superintendence	2.65	1.15	1.15
Labor on tanks and screens	1.00	1.50	2.05
Disposal of sludge or screenings		1.00	.50
Chlorination		4.05	4.05
Gross cost	20.98	12.14	12.35
Revenue	10.66		
Net cost	10.32	12.14	12.35

The results of these experiments have warranted the New Haven Committee in recommending the Miles process for adoption by the city of New Haven, and that a plant be built first at the East Street sewer, which discharges 16 000 000 gals. daily, and, if this plant be successful, the sewage from the other outfalls should be treated.

Winslow and Mohlman's paper is an eminently fair report of the results of a thorough investigation. They have given this new proposition just the treatment it should receive, namely an unbiased discussion to bring out all important points, both favorable and unfavorable. In so doing they have made two criticisms, both of which are unfavorable and call for comment and explanation. F. W. Mohlman* states that the effluent containing as it does bisulphites and free sulphur dioxide, has the power of deoxygenating several volumes of diluting water, and apprehends that a zone of deoxygenated water will be formed about the point of discharge of the acid effluent. Although not so stated, the implication is that such a zone might cause a nuisance or be injurious to fish life. Otherwise there would be no need for considering it a danger. The question raised is whether or not effects would be produced which would call for the aëration of the effluent. Mohlman's laboratory experiments show the effect upon the dissolved oxygen and sulphur dioxide contents of diluting the Miles process effluent with varying volumes of New Haven harbor water. The results are given in the following table:

TABLE 5.

MIXTURE OF HARBOR WATER AND MILES EFFLUENT.

	Effluent.	Harbor Water.	1 Eff. to 2 Water.	1 Eff. to 4 Water.	1 Eff. to 9 Water.	1 Eff. to 19 Water.
Dissolved oxygen...........	0.8	12.0	1.0	5.0	8.8	11.0
Sulphur dioxide............	118	0	8	0	0	0

This table shows that in a dilution of 2 of harbor water to 1 of effluent, the oxygen is reduced from 12 parts to 1 part per million, and the sulphur dioxide from 118 to 8 parts. At a dilution of 4 to 1, the oxygen is decreased five times, and the sulphur dioxide has disappeared. At a dilution of 9 to 1, the oxygen is 73 per cent., and at a dilution of 19 to 1, 92 per cent. restored.

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* F. W. Mohlman. Miles Acid Process May Require Aëration of Effluent. *Engineering News-Record, 81*, 235, August 1, 1918.

Polluted waters produce nuisances when they putrefy and give off the products of the decomposition of organic matter containing sulphur. They putrefy if the oxygen is exhausted before the organic matter is oxidized. In other words, the bacteria will oxidize the organic matter to the limit of the oxygen, and if any organic matter remains, the bacteria of putrefaction will attack it and produce the well-known conditions.

TABLE 6.

CONTINUOUS AËRATION OF MILES EFFLUENT.

Date.	Sulphur Dioxide, Influent.	P.P.M. Effluent.	Reduction, Per Cent.	Air per Gal. Cu. Ft.
March 6, 1918	99.1	44.9	54	0.10
March 7, 1918	70.4	14.4	79	0.10
March 8, 1918	72.3	14.4	80	0.11
March 9, 1918	69.1	5.2	92	0.10
March 10, 1918	81.3	46.4	43	0.10
March 11, 1918	80.9	36.1	55	0.06
March 31, 1918	53.8	10.2	81	0.10
April 1, 1918	108.5	37.4	65	0.10
April 2, 1918	90.9	26.5	71	0.10
April 3, 1918	71.0	19.8	72	0.10
April 4, 1918	92.2	4.5	95	0.10
Average	78.1	23.6	70	0.097

The Miles acid effluent does not represent the same conditions as those which exist in a deoxygenated, polluted water, because, in the case of the effluent, the deoxygenation has been produced chemically, not biologically, and the organic matter present has been practically sterilized. Furthermore, the settleable solids which might form sludge banks near the point of discharge have been largely removed. Before a nuisance can occur, bacteria must be introduced and be given a chance to multiply. Meanwhile dispersion and dilution are doing their work, and reaëration is taking place. Then there exists the condition of a warm, practically sterile effluent, free from sludgeforming suspended matter, being discharged into a considerable body of water, to the surface of which it will tend to rise and spread in a thin layer, thereby becoming subject to the reaërating effect of the wind, currents, passing craft, etc.*

Mohlman showed that the sulphur dioxide may be removed by aëration before dilution with harbor water, and after aëration the effluent will not deoxygenate large volumes of diluting water. The average results of various aëration experiments using compressed air admitted through a " Filtros " plate into a shallow aërating tank providing a detention period of thirty-one minutes are as follows:

From the results of these experiments, Mohlman concludes that 70 per cent. of the free sulphur dioxide may be removed by blowing the effluent in a shallow tank with 97 000 cu. ft. of free air per million gallons of sewage. This degree of aëration is about one twentieth of the 2 cu. ft. per gallon commonly used in connection with the activated sludge process.

Oesten, also G. C. and M. C. Whipple, and others, have shown that the aëration of water, which is in this case the interchange of oxygen and sulphur dioxide, may be accomplished more economically by the use of riffles, sprays or cascades, than by aëration with compressed air. The latter method is rarely if ever used in water-works practice. In the case of the Miles effluent we believe that a sufficient degree of reaëration could be secured by discharging the effluent over a series of riffles, or, if that plan were impracticable, by pumping the effluent through a suitable aërator, in the latter case at a cost of less than $1.00 per million gallons.

Fish life could hardly be affected, for the only place where fish could get into any considerable depth of deoxygenated water would be close to the outlet. Elsewhere they would not be affected unless they swam on the surface, which fish would not do ordinarily.

Pearse's statement in connection with experiments at Chicago† — namely, that the acid effluent has a lower oxygen requirement than ordinary tank effluent — is evidence that, while the effluent contains no oxygen, less is required for the oxidation of the remaining organic matter than in the case of settled sewage.

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* Mohlman, *loc. cit.*

† Report on Industrial Wastes, *loc. cit.*

It is therefore our opinion that under ordinary conditions of discharge into rivers or harbors, the dispersion, dilution and reaëration of the acid effluent would be much more rapid than the development of putrefaction and consequent nuisance; and in rare cases where aëration might be necessary it could be accomplished at a cost which would not militate against the usefulness of the process.

The second point, — namely the presence of unsaponifiable matter in the recovered grease has already been referred to above, and it is one of great importance, as it makes necessary the distillation of the grease.

The value of the grease from the Boulevard sewage is estimated at 8.5c. per lb. to the producer. This is the judgment of the Falk Company of Pittsburgh, who distilled a sample of considerable size. This is about one half the current price of good, saponifiable grease, containing less than 4 per cent. of unsaponifiable matter. Evidently the value which has been assigned to the recovered grease in previous statements regarding the economy of the Miles process should be correspondingly reduced.

Massachusetts State Experiments.

The New Haven authors have referred to the report on the Miles process made by Messrs. Goodnough and Clark of the Massachusetts State Department of Health to a commission appointed by the legislature, and presented by that commission to the legislature early in 1918, and have stated that " these Massachusetts experiments [by X. H. Goodnough and Harry W. Clark] were made on a small scale in bottles, and an eighteen-hour sedimentation period was used, which seems somewhat unfair to the acid process which accomplishes the same results in four hours. The disinfection of the effluent, and the freedom of the process from nuisances, is, of course, ignored in such a comparison." As this report is made by a Massachusetts commission, and because its conclusions are contrary to the New Haven results, we believe it warrants discussion.

The experiments of Goodnough and Clark were made with three 2-gal. samples made up of aliquot hourly portions collected one day each week for several weeks. The sampling was apparently fair, but on account of the infrequency of the samples could not have been as truly representative as the portions of sewage used during the tests made by the Massachusetts Institute of Technology, amounting to a hundred thousand gallons of sewage. The small samples of sewage were acidulated with sulphur dioxide gas, settled, and the sludge collected and analyzed. While it is true that the sewage was treated with acid, enough departures were made from the Miles process so that it can hardly be called a test of that process.

The results compared with the Technology experiments show that 61 per cent. as much acid was used and 75 per cent. as much sludge; and 79 per cent. as much grease was recovered. These lower results may have been due either to a weaker sewage, or to insufficient acidification. But the most radical departure from the Miles process was in the use of an eighteen-hour period of subsidence in place of the four-hour period used in the Miles process. Using the longer period of subsidence, the state authorities came to the conclusion that there was not enough difference (25 per cent.) between the amounts of sludge obtained to pay for the acid used. In this conclusion no attention was paid to one of the cardinal points of the Miles process, namely that acid is used to accelerate precipitation; therefore it was hardly fair to compare it with an eighteen-hour period of subsidence, particularly so because no engineer would ever consider the use of so long a period of plain subsidence for the treatment of sewage.* The plan would be prohibited by the initial costs of the work, the local nuisances produced, and the small amount of purification effected by the treatment. Conditions at Moon Island — where sewage is stored about four hours, on an average — which are bad enough, only approach those which would exist were sewage stored eighteen hours before discharge, and it is abhorrent to contemplate what the conditions would be if the sludge from these tanks could not be discharged with the sewage, but had to be otherwise disposed of. These were the conditions which in a great measure prevented the success of the plant at Cassel, Germany.

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* It is obvious that if sewage be held for a period of days, all of the settleable solids would subside, and there would be little or no difference in favor of acid treatment, assuming, of course, that fermentation would not interfere with plain subsidence, as might be expected.

Apparently the report of the Massachusetts commission attaches little importance to the sterilizing effect of the sulphur dioxide and the absence of local nuisance, although that point was brought out in the report of the experiments conducted by the Massachusetts Institute of Technology. Furthermore, Winslow and Mohlman state that " it is particularly important from the point of view of the practical sewage-works operator to note that both effluent and sludge were so affected by the acid present as to be stable for considerable periods, so that with a plant of this type no local nuisances need be anticipated. During the whole period of our experience, there were only one or two occasions on which slight signs of septic action were noticed in the tank, and the sludge was stored in barrels for weeks without the production of offensive odors." They also state that " above all, however, the thing that counts most heavily in favor of the Miles process under the conditions obtaining at New Haven is its freedom from nuisance."

In view of the local nuisance produced by many a bacterial tank and filter, we believe the stability and freedom from nuisance of the Miles process effluent and sludge are worthy of all the consideration which previous experimenters, with the exception of Messrs. Goodnough and Clark, have given it.

The Practicability of the Process for Boston Sewage.

It is interesting to apply the New Haven estimates of cost to the results of the experiments with Boston sewage which have been made under our direction. These experiments showed that Boston sewage yielded about 1 500 lbs. of degreased tankage, containing 4.53 per cent. of ammonia; also about 400 lbs. of recoverable grease per million gallons. With fertilizer ammonia at $4.00 per unit, the tankage is worth $18.12 per ton, or $13.59

per million gallons of sewage. Using 8.5c. as the price per pound for the recovered grease (which seems fair because this was the estimated value of the New Haven Boulevard sewage which contains about the same percentage of unsaponifiable matter as the Boston sewage), the grease would be worth $34 per million gallons.

Modifying the New Haven costs to correspond with the stronger Boston sewage, we have determined the costs as given in the following table, which also shows the costs of treatment of the Boulevard sewage of New Haven. We have not used the East Street sewage for comparison because it is not representative; it contains an unusual amount of machine oils and wastes from the metal industries.

TABLE 7.

COST PER MILLION GALLONS OF TREATING 100 000 000 GALLONS OF CALF PASTURE SEWAGE DAILY, APPLYING THE UNIT COSTS ESTIMATED BY WINSLOW AND MOHLMAN FOR 16 000 000 GALLONS OF NEW HAVEN SEWAGE DAILY.

	Calf Pasture Sewage.	Boulevard Sewage.
Tanks and buildings	$2.47	$2.47
Acid treatment	18.65	10.74
Drying sludge	10.35	2.04
Degreasing sludge	9.12	1.91
Redrying tankage	.10	.17
Superintendence	1.06	2.65
Labor on tanks and screens	1.00	1.00
Total cost per million gals	$42.75	$20.98

In applying the New Haven unit costs, we have made no subtraction on account of the larger plant or the available tanks at Moon Island. Unit costs for all items except superintendence and labor are those used for Boulevard sewage; the unit costs for superintendence and labor are those used for East Street sewage.

The estimated net financial result of operation is given in the following table.

In the above we have estimated the price of ammonia at $4 per unit. This is low at present. When ammonia is worth $4.50 a unit, the gross revenue would be $49.29, and the profit $6.54 per million gallons, and at $4.75 per unit, the gross revenue would be $50.14 and the profit $7.39 per million gallons. While the above estimate shows a profit under present conditions, it is probably true that under pre-war conditions the process would not produce a revenue; and in their conclusion, Winslow and Mohlman state that "our experience with New Haven sewage lends no color to the hope that a net financial profit can be obtained by the use of the Miles acid process, unless with sewage of exceptionally high grease content and low alkalinity."

TABLE 8.

Estimated Financial Results of Operating the Miles Acid Process at the Calf Pasture.

	Per Million Gallons.
Revenue:	
From tankage	$13.59
From grease	34.00
Total gross revenue	$47.59
Expenses:	
Estimated cost of treatment	42.75
Profit on above basis	$4.84

One may rightly question the values of any conclusions based on pre-war prices, because the present evidences indicate that the prevailing prices will not be lowered immediately, and they may never reach their pre-war level. This is particularly true of labor which is the principal factor in the costs of materials. At present high prices it seems as if the Miles process would be profitable at Boston, and this favorable condition would gradually disappear as the rate of fall in prices exceeding the rate of fall in cost of operation comes into effect.

The materials produced are fertilizer and grease, and it does not seem likely that the demand will decrease rapidly. The materials used for purification are sulphur, pyrite, niter cake and the sulphur acids. The war has stimulated the production of all these materials, and now that the abnormal demand has ceased they should be cheap.

Therefore we feel that in many cases it is likely that the Miles process might be operated at a slight profit for some time to come, and, in any event, operated at a cost lower than that for any other process producing the same grade of clarification and disinfection.

OTHER ADVANTAGES OF THE MILES PROCESS.

In addition to the advantage due to the freedom from nuisance, the stability of effluent and sludge, and those due to the compensating value of the recovered products, there are still other advantages which should be reckoned with.

Sanitary Efficiency a Necessary Concommitant.

All are aware that modern sanitary engineers are designing sewage disposal works to purify sewage to the degree to which the body of water into which the effluent is to be discharged demands and as the financial conditions will allow. In so doing they often sacrifice a desirable degree of clarification, as when only subsiding basins or screens are used; or a high degree of nitrification, as when high rates of filtration through coarse material are employed; but with the Miles process it is a fundamental necessity, in order to recover the valuable products upon which the cheapness of the process depends, to at the same time disinfect the effluent and attain a much higher degree of clarification than can be obtained by screening or plain subsidence. Therefore there is little temptation to sacrifice safety for cheapness.

The sludge from the Miles process contains much less moisture than activated sludge, and about the same as the subsiding basin sludge and the Imhoff tank sludge, as the following table shows.

As compared with activated sludge, the advantage of handling less than one seventh of the volume of activated sludge is obvious.

TABLE 9.

Kind of Sludge.	Average Percentage of Moisture in Sludge.	Relative Volumes of Sludges Containing the Same Amounts of Dry Matter.
Activated sludge	98.5	100
Subsiding basin sludge	91.5	18
Miles Process sludge	90.0	15
Imhoff tank sludge	89.0	13.6

Installation Cost.

The devices required for the operation of the Miles process are the following:

Devices for producing sulphur-dioxide gas, and for feeding niter cake or other forms of acid.
Subsiding basins.
Sludge-handling apparatus.
Sludge driers.
Grease extractors.
Grease stills.
Tankage driers and grinders.

While the list is formidable and is enough to rule out the process for small plants, in the case of a city like Boston, however, the cost should not exceed $15 000 per million gallons, daily capacity.

Further Information Necessary.

While all of the large-scale trials of the process have been giving promising results, it is true that the drying and degreasing of sludge has never been practiced on a large scale. All of the estimates are based upon small-scale trials and the opinions of engineers and of manufacturers who have handled similar materials. There is great need, therefore, for a large-scale experiment with normal sewage to determine the actual possibilities in practice. This experiment should be made on a scale large enough to determine beyond all doubt the costs of drying and degreasing and the possibility of marketing the products. It might cost $50 000.

Adaptability of the Process.

In the words of Winslow and Mohlman,— "For communities where clarification and disinfection are desirable,—where screening would be insufficient and nitrification unnecessary,— the process of acid treatment comes fairly into competition with other forms of tank treatment; and that it is particularly suited to dealing with sewages which contain industrial wastes and for use in localities where local nuisances must be avoided at all costs and where sludge disposal could be provided for only with difficulty." This means that in 90 per cent. of the cases where a large volume of strong sewage is discharged, the Miles process is worthy of consideration.

Conclusions.

We conclude the following from the results of the various experiments and studies:

(1) The Miles process will produce a well disinfected effluent from which 90 per cent. of the settleable solids have been removed.

(2) Whereas it requires for its accomplishment devices for the chemical treatment of the sewage and for drying and degreasing the sludge, competent supervision is necessary.

(3) On account of the nature of the plant and the relatively high cost of operation for small installations, it is not well adapted for the purification of small volumes of sewage.

(4) Its operation should cause no local nuisances.

(5) It causes the removal of over 99 per cent. of the bacteria.

(6) The effluent remains stable long enough for the neutralization of the excess acid, and the oxidization of the sulphites and the sulphates by dilution.

(7) As compared with the activated sludge process, the volume of sludge is very small.

(8) Compared with the cost of the oxidation processes, the cost of installation is low; it is somewhat higher than that for Imhoff tanks with chlorination.

(9) The products recovered are valuable, and their recovery would effect a conservation of natural resources.

(10) Apparently it is the most economical process for producing so well clarified and so stable an effluent, and under present conditions it seems as if it could be installed and operated at a profit in those larger cities where the conditions are favorable.

(11) To determine the costs of sludge drying and degreasing more accurately than is possible from the available data, a large-scale experiment is urgently needed.

DISCUSSION.

HARRY W. CLARK.* — As Mr. Weston has thrown a few bricks in my direction I wish to make one or two remarks in regard to his paper and this process.

In the first place, I feel quite sure that when Mr. Dorr and Mr. Weston read their papers in regard to it a year or two ago, they stated that from their figures a profit could probably be realized from the working of this process; that is, the sale of grease and sludge would more than pay all costs. A year or two ago, as Mr. Weston has called attention to, a commission was formed by the legislature providing for an investigation of the discharge of sewage into Boston Harbor, this commission consisting of Dr. Henry P. Walcott, chairman of the Metropolitan Water and Sewerage Board; Dr. Allan J. McLaughlin, at that time commissioner of the State Department of Health; and Mr. Edward Murphy, then commissioner of public works of the city of Boston. A resolve was passed by the legislature asking this commission "to determine whether there is any practical, economical way of removing from sewage any merchantable products contained therein." This was the commission and the resolve under which Mr. Goodnough and I worked. If you read the resolve you will see that we were not asked specifically to investigate the Miles acid process to determine its value in sewage treatment; that is, from a sewage disposal point of view and in regard to the destruction of bacteria by it, but, as I just said, "to determine whether there is any practical and economical way to remove from sewage any merchantable products contained therein." The resolve carried an appropriation of $5 000, but as it did not seem possible that with this small sum an investigation could be made extensive enough to answer definitely the question asked, the commission decided not to expend any of this money, and of course such experiments as were made by me were on a very small scale.

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* Chief Chemist, Mass. State Department of Health, State House, Boston, Mass.

During the past year, however, we have spent some ten months in investigating a portion of this process on a larger scale with the sewage of Lawrence, and I shall have something to say later in regard to it; but it did not seem from the many investigations at the experiment station of the State Department of Health at Lawrence and from our general knowledge of the subject that this process could be made a financial success; and nothing so far done either by Mr. Weston or at New Haven has changed my opinion in regard to that part of the process.

We had before us, when our report was made, the example of the manufacturers of the city of Lawrence, who discharge, and have continued to discharge for years, in spite of the investigations and statements of the State Department of Health, many thousand gallons daily of very strong wool liquor into the Merrimack River, a liquor much of which contains two hundred times as much grease to the gallon as in the Moon Island sewage, and a very high percentage besides of potash, — a substance of great value, as you all know, but found in only minute amounts in domestic sewage. Within the last two years, however, certain firms, one, I believe the Diamond Match Company, working in conjunction with the American Woolen Company, and another, the North Star Chemical Company, so called, have taken the strongest wool liquor from these mills and have extracted in one case both grease and potash, and in the other case, grease only. None of these business men will take anything but the strongest liquor to treat, however, — that containing the greatest amount of potash and fats, — and there continues to be discharged into the river daily many thousand gallons of wool liquor containing infinitely more fat and potash than found in Moon Island and other domestic sewage. I may add also that these plants would not have been started at Lawrence, nor the money invested there to carry them on, except for the scarcity of grease and potash due to the world war. With that example before us, we could not quite see how the Miles process could possibly be a financial success to the city of Boston. I have no doubt, however, that the Miles process may have a place in sewage *disposal*, but very extensive experiments will have to be made in regard to the apparatus best adapted and the methods best adapted to drying sludge and recovering and distilling grease, etc., before an absolute statement can be made concerning its value as a recovery process.

ALMON L. FALES.* — I think the Miles acid process offers sufficient promise to warrant a large-scale test such as that recommended for New Haven, and therefore I heartily concur in the conclusion of Mr. Dorr and Professor Weston that such a test is needed. It is only in this way that it will be possible to demonstrate whether the Miles process can, in an economical and satisfactory way, without nuisance, be made to yield a sufficient revenue from the sale of grease and fertilizer to render this method less expensive than the well-established method of Imhoff tank-chlorination treatment, for example, which will accomplish the same objects of clarification and disinfection.

The cost of the acid treatment will vary with the alkalinity of the sewage to be treated. For the East Street sewage in New Haven, which is now abnormally low in alkalinity, due to certain industrial wastes, Professor Winslow and Dr. Mohlman estimate the gross cost of treatment by the Miles acid process to be $15.50 per million gallons, against $11.99 per million gallons by Imhoff tanks and chlorination; whereas for the normal domestic sewage from the Boulevard sewer, they estimate the gross cost of the Miles acid process to be $20.98 per million gallons against $12.14 per million gallons by Imhoff tanks and chlorination. In the latter case the net return from recovery of by-products must be more than twice as much as in the former case, to reduce the net cost of the Miles acid process to that of the Imhoff tank-chlorination process without recovery of by-products. The alkalinity of the sewage in different cities will vary with the alkalinity of the water supply and the presence of acid or alkaline wastes in the sewage.

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* Of Metcalf & Eddy, Consulting Engineers, 14 Beacon Street, Boston, Mass.

HARTLEY L. WHITE.* — This problem seems so vital to the welfare of the cities and towns throughout the country, and is one that is going to be of very great interest to my own community, that I have been very much interested in the paper. The question of financial success of a process of this kind seems to me a relative one. If the operation of this process produces a reduction in cost, so that it is possible to use this process rather than some more expensive one, as suggested by Mr. Dorr, then it seems to me that enters into the question of financial success. I do not take it that a financial success in a thing of this sort means that a profit is going to be made out of the effluent or use of the process, — an actual income over expenses. That does not seem to me necessary to constitute a financial success; but certainly this comes the nearest to anything I have ever heard of being a successful treatment of sewage, and one that must interest every city and town, especially inland cities and towns, and also places on the coast but removed from the metropolitan sewers. I have felt for a good many years that the Massachusetts State Department of Health required a higher degree of purification than was actually necessary, and that towns and cities were being put to expense beyond which they ought to go, to produce that purification. I may be mistaken, but that is my impression. Now, if we have a process that will bring about a degree of purification sufficient to allow the effluent to be turned into the nearest stream or tidewater without injury we have something we have been looking for a good many years, and the question of experimentation seems to me of sufficient importance to make it advisable to introduce a bill — why not let it come from the Boston Society of Civil Engineers? — into the legislature, to obtain sufficient funds to carry on some experiments along the lines suggested by this paper. I believe the process is of such general interest and value to the Commonwealth that it ought to be done, and I have little doubt that such a bill would pass.

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* Civil Engineer, Braintree, Mass.

George A. Carpenter.* — I should like to ask a question. I understand that the commission at New Haven recommended the adoption of the Miles process for the sewage from one section of the city, but not from what they called the "Boulevard" section. Does that indicate that there is not sufficient flexibility in the process to meet varying conditions, and does it lead to the interpretation that if the process were sufficient in one case, with the passage of time and changing conditions of sewage later on it might become insufficient and inadvisable?

Mr. Dorr. — I have been very much interested in the development of this process, for the reason that it seemed to me to be a reasonable, common-sense treatment of this vexed problem. It certainly is common sense to recover from the sewage whatever there is of value that can be recovered, and use that value as an offset to the cost; and whether that value balances the cost or whether it more than balances it so that it produces a revenue, or whether it does not balance but only reduces the net cost, — economy is there just the same and should be enjoyed; and this process recovers a larger value in total than any other process that I know of. Mr. Weston may not wholly agree with me, but I think in every case it will show a lower net cost than any other process in which there is a good degree of sterilization, and will answer the requirements better. And what are these requirements? Why, to do no more than is really necessary and to do it as cheaply as possible and avoid nuisance at all costs. That is what they want everywhere and is just what this process does, and I think when it becomes better known it will be widely adopted, just for that reason. The reason it is difficult to get communities to treat their sewage isn't because they want to be dirty or impose their filth on neighboring communities, it is because of the cost of the well-recognized processes, which are a serious tax on many communities. Now, if they can be shown a process which is reasonable in cost and satisfactory in itself, and particularly is free from nuisance, I think the situation will be changed and there will not be that resistance to health officers. Even if it is self-sustaining, it will be comparatively easy to get action, because none of the other processes are as economical as that. One little point I might make, — Mr. Weston didn't touch upon, — that is, that this is a chemical process; that is, a positive process. It is not subject to any interference from change in temperature, as bacterial processes are. There is also one more point that does not appear in a comparison of the actual costs at the disposal works. Since the process is such that there is no nuisance, it does not need to be located at a long distance from a city. In almost all others there is some nuisance, and for that reason a site is called for at a considerable distance from the city; that means that a large volume of sewage has to be carried by a large sewer for a considerable distance, — sometimes many miles. Now, that can be entirely avoided, for a process that produces no nuisance can be located near the city. This does not show in actual cost of working the process, but is really a saving, just the same.

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* City Engineer, Pawtucket, R. I.

Mr. Weston. — The New Haven sewage discharges through half a dozen sewer outlets, and two of them were experimented with, — the East Street and the Boulevard. The former discharges a sewage consisting largely of metal-trade wastes, while the latter discharges a sewage very much like that of the city of Boston, — though a little weaker. The Boulevard sewer discharge, however, is small, — only 2 or 3 M.g.d., while the East Street sewer discharges 16 M.g.d. The plan at New Haven is to establish complete works, including drying and distilling machinery, at the East Street sewer outlet, and then, if the plant be successful, build acid-treating plants at the other outlets; obtain the sludge; bring it over to the East Street works and there complete the process. On account of the relatively large overhead cost on the drying and degreasing machinery it wouldn't be practicable to establish a plant at one of the smaller outlets with any chance of its being a success, but there is a chance at the East Street sewer.

I wish to state again that our knowledge of this process is not complete. We know how much nitrogen is in the sewage, how much the acid treatment will probably cost, how much sludge we can get and how much water it contains. We also agree that the activated sludge process, as claimed, is one which may be operated at a low cost, on account of the recovery of salable products from the very voluminous sludge; but the activated sludge process requires air for aëration, which is nearly as expensive as acid for precipitation. Now, starting on very nearly equal terms, we have, in the case of the acid process, the problem of drying and degreasing a sludge 6-7ths less in volume, containing a little less fertilizer but more grease per million gallons than the activated sludge. Therefore, if the somewhat optimistic claims for the activated sludge process hold good, the claims for Miles process must likewise hold good.

As Mr. Fales and Mr. Clark have both said, there is a lot of work yet to be done, and although a great deal has been done in England and elsewhere the physical problems of drying and degreasing the sludge are considerable. Sewage sludge " balls " in a rotary drier; does not dry to a granular mass like other substances. The balls must be disintegrated before they will dry; and again sludge must be concentrated roughly to 80 per cent. of water (20 per cent. of solids) before it can be put into a drier and handled. That may mean concentration by decantation, or some rough form of pressing, or a little more acidification to dewater the sludge. Also with the Miles process we have an acid sludge yielding an acid grease. Its distillation must be accomplished with superheated steam. Anybody with experience with superheated steam knows that the plant must be well designed and all the features must be worked out by large-scale experiments before the cost can be approximated well enough to enable an engineer to say that he can design a Miles-process plant which will be successful.

I am sure that we had no intention of " throwing any bricks " at Mr. Clark; we simply wished to show that the acid process which was experimented with in accordance with the request of the legislature, to see if recoverable products could be secured from the sewage of Boston, was not exactly what we call the Miles process, — namely, the treatment of sewage with acid with a short period of subsidence, and again we could not understand quite why our more elaborate and longer experiments showed higher sludge and fat values. However, these latter are discrepancies which might occur again under conditions which may not be anticipated.

Just one word about the practice in the Lawrence mills. It is a well-known fact that wool-scouring wastes can be treated with acid and practically 99 per cent. of the grease removed, and all plants which have used this process during the war have been immensely profitable. I personally know this is true. But the plants in Lawrence (and I say this because we have designed one of them) are all centrifugal-machine plants; that is, plants in which the wool-scouring wastes are treated by passing them, after subsidence, through a special centrifugal machine which does not remove over 60 per cent. of the fats from the stronger wool-scouring wastes. This probably explains, Mr. Clark, why the strongest wastes were used, because if one should take the weak wool-scouring wastes from certain Lawrence mills, containing the effluent from the third and fourth bowls, the results would be disappointing and not profitable.

During the war a large number of mills located away from Lawrence have appreciated the advantage of recovering the centrifugal grease. In fact, outside of one large company, they have generally done so, and have in many cases paid the cost of construction out of profits.

Wool wastes which contain about 1 to 1.5 of potash in combination with organic matter cannot now compete as sources with the waters of western lakes containing as much potash and no organic matter.

However, the paper which we are discussing is about sewage disposal, not about the grease business. The grease business must be attractive to investors to insure success. Cities are compelled to dispose of sewage, and therefore any process like the acid process, which offers the possibility of a good degree of purification at a low cost, should receive the respectful consideration of those interested in sewage disposal, at least until its claims are disproved by a large-scale investigation.

Mr. Clark. — I do not quite agree with what Mr. Weston says about Lawrence. Before the war we could not get any business men or manufacturers interested in the project of recovering grease and potash. It is, I have no doubt, a profitable business at the present time, but allow me to repeat that at Lawrence they are still wasting an enormous amount of fatty matters and potash into the river. Mr. Weston states that the centrifugal machines at Lawrence only collect about 60 per cent of the fatty matters. This is probably true, but if they would treat by the centrifugal process much of the liquor still wasted, and still only recover 60 per cent, they would recover many times more grease per gallon, to say nothing of potash, than is found in the richest Moon Island sewage. Let me add also that the centrifugal machines located in the mills are but the beginning of the processes carried on at Lawrence, the concentrated liquor being always treated at the two central plants I have mentioned. I am quite sure, moreover, that Mr. Weston did not design either of these two plants.

I think the Miles process might well be divided into two parts; first, it should be considered as a process for the treatment of sewage with SO_2 for carrying down sludge and thereby clarifying sewage and also sterilizing the sewage; and the second part is the theoretical portion in regard to its value, to the city installing it, as a recovery method, — can it be made profitable? Frankly, I do not think it can, especially as it would be carried on under city control rather than business control. Mr. Weston has criticized the fact that in the experiments made for the commission, the sewage was given eighteen hours' sedimentation both without and with acid treatment. As a matter of fact, however, the sewage collected by employees of the city of Boston was twenty-four hours old when reaching the laboratory, and usually arrived there late in the afternoon. It was then of little account whether it was settled four, eight or eighteen hours; in other words, about everything that was settleable without chemical treatment went down in four hours, and little, if any, more in eighteen.

Mr. Weston.* — This stale sewage was, therefore, not normal.

The speaker would like to close with a personal word:

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* Author's closure.

The acid treatment of sewage has been brought into the public eye largely because of the devotion and initiative of one man, and that man is Mr. Edgar S. Dorr. I would not be here reading this paper to-night if it were not for him. He became acquainted with Mr. Miles some years ago, and they interested themselves in the problem this paper described. Mr. Dorr was unable to see why the process should not be successful if the details could be worked out, as he believed they could. He has always felt that " the only difference between the possible and the impossible is that the impossible takes longer "; and his devotion has renewed interest in the possibility of recovering valuable by-products from sewage. In 1915 he read a very candid and illuminating paper before the officers and students of the Department of Public Health at the Massachusetts Institute of Technology, with the result that Professor Sedgwick, noted for his ability to pick out the good from the trash, thought the subject worthy of consideration and study. In my opinion, Mr. Dorr has been the most important factor in causing other investigators to study this problem, and in giving the Miles process its present standing.

MEMOIRS OF DECEASED MEMBERS.

THOMAS ASPINWALL.*

Thomas Aspinwall, the son of William and Arixene Southgate (Porter) Aspinwall, was born in Brookline, Mass., September 5, 1853, and died in that town, March 2, 1918.

He was educated at private schools in Boston and at St. Mark's School in Southboro, and was graduated with the class of 1876 at the Massachusetts Institute of Technology.

After a short visit to England and France, Mr. Aspinwall in February, 1877, formed a partnership with Edwin H. Lincoln, opening an office in Boston under the firm name of Aspinwall & Lincoln, Civil Engineers and Surveyors, which is still a well-known firm in the city, and one with which Mr. Aspinwall was associated at the time of his death.

He married, on February 3, 1887, Alicia Stuart Towne, of Brookline, and is survived by his wife and two children, Lieut. Thomas Gardener, now serving in France, and Philip Channing.

Mr. Aspinwall's family was one of the most distinguished in the early history of Brookline and Boston. He inherited many of the most excellent qualities of his ancestors, and was at all times a most attractive and delightful companion. He was fond of nature, and as a recreation from professional duties he loved to wander through the woods and fields with gun and dog.

Mr. Aspinwall's tastes were also inclined towards military affairs; between 1879 and 1882 he was a member of the First Corps of Cadets, and later, 1889–91, served as engineer on the staff of General Bridges, with the rank of captain.

Mr. Aspinwall became a member of the Boston Society of Civil Engineers, March 17, 1880, and of the American Society of Civil Engineers, May 2, 1888.

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* Memoir prepared by Desmond FitzGerald and Edwin H. Lincoln.

FREDERICK BROOKS.*

Frederick Brooks was the son of Francis A. and Frances (Butler) Brooks. He was born in Boston, Mass., on July 17, 1848, and died in that city, on January 10, 1919.

Fred. Brooks, as he preferred to be known, was a graduate of Harvard in the class of 1868. In college he was distinguished for proficiency in mathematics, a success which naturally led him later to enter the Massachusetts Institute of Technology, where he studied engineering (1868–70). After leaving the Institute he entered the service of Shedd & Sawyer, at that time a leading firm of civil engineers in Boston.

In 1881 Mr. Brooks joined the staff of the Mexican Central Railroad, and for two years was engaged in location on the Tampico Division, where he gained experience in the running of preliminary and location lines, which led to further engagements in similar work for other roads, notably for the Nashua & Lowell Railroad, in whose employ he remained for three years.

Mr. Brooks became a member of the Boston Society of Civil Engineers in 1874, and for the rest of his life was deeply interested in the growth and success of that Society. He was librarian from 1878 to 1881; director from 1890 to 1894, vice-president from 1902 to 1904, and was elected president in 1904. He was first connected with the American Society of Civil Engineers as junior, on June 7, 1876, and on January 2, 1884, was elected member.

In 1890 Mr. Brooks entered the service of the Boston Water Works as an assistant engineer, and was assigned to the South Framingham office, where he remained for eight years, working upon many important problems connected with the maintenance and construction of an extensive system of water supply. When this work ended he returned to his office, 31 Milk Street, and resumed his private practice.

Fred. Brooks possessed a keen literary sense which found expression in the writing of professional papers and in the editing of the *Journal of the Association of Engineering Societies*. His papers were for the most part connected with the proposed introduction of the metric system, a project in which he was much interested, but he found time to write on "Mexican Notes," December 19, 1883, and "Sewage Disposal" at Medfield, Mass., July, 1888.

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* Memoir prepared by Desmond FitzGerald.

The Association of Engineering Societies was a widespread movement among the local engineering societies for a closer union in connection with the publication of papers. The idea originated with the Cleveland Society in 1881, and it was carried out successfully for many years until the rapid growth of the local societies rendered it undesirable to continue the joint publication. Mr. Brooks served as editor of the *Journal*, 1905–13. The duties were arduous, but he fulfilled them with ability and fidelity.

Mr. Brooks's death was accompanied by several tragic features. His health was already somewhat impaired, when he was awakened during the night of December 13, 1918, by the smell of smoke in his room. After a hasty examination he found that the upper story was on fire. On that floor the housekeeper was sleeping. Without thought of self, he seized a fire extinguisher and fought the fire at close range, so effectively that he had almost mastered the flames when the fire department appeared and completed the work. Mr. Brooks's head, face and hands were badly burned, and he was carried to the hospital, where he lingered until January 10, 1919, when he passed to his long rest.

Fred. Brooks will long be remembered in Boston, where he was for so many years an interesting and prominent member of our engineering fraternity.

CHARLES HEMAN DODD.*

Charles Heman Dodd was born in Worcester, Mass., September 27, 1855, and was the son of Joseph H. and Martha E. Dodd.

He prepared for the Chandler Scientific Department of Dartmouth College at Worcester Free Institute, now Worcester Polytechnic Institute, entering the freshman class in September, 1874.

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* Memoir prepared by R. J. McNulty and E. S. Dorr.

Upon leaving Dartmouth he followed the calling of draftsman and mechanical engineer with signal success.

In 1877 Mr. Dodd entered the office of N. C. Lombard, M. E., State Street, Boston, where he studied for three years. From 1880 until 1886 he was engaged in designing machinery, and from then until 1888 was with the Boston Heating Company as chief draftsman. From 1888 and for three years he was draftsman for the Metropolitan Sewerage Commission, and later was engaged with the Plymouth Cordage Company, designing machinery.

In 1892 he was employed by the city of Boston, and from 1903 until the time of his death he was mechanical engineer in charge of the designing department of the sewer service, Public Works Department.

He designed two sewerage pumping stations for the city of Lynn and four for the city of Boston. He possessed inventive talent of a high order, combined with a well-balanced faculty for practical application of ideas to the work at hand.

Mr. Dodd was an ardent yachtsman and a lover of all water sports. He was a member of several yacht clubs and of the Dartmouth Club of Boston. Interested and successful at yacht designing, he spent many of his spare hours at this work.

He was fond of nature and outdoor life in many forms, and was in the habit of taking long walks over the country roads and through the woods and fields, and liked to persuade old friends to accompany him. Because he was captain and stroke of the crew in vain attempts to revive rowing as a Dartmouth sport, he was known in college days, and still is fondly remembered among the Dartmouth men, as "Skipper Dodd."

Mr. Dodd was married, in 1900, to Miss Frances Cox, of Denver, Colo., who survives him. He was a man of sturdy New England type, of high ideals and principles, and possessed the warm friendship of all who knew him well. The end came suddenly, of heart disease, at his home in West Roxbury, on October 27, 1918.

Mr. Dodd joined the Society September 18, 1901.

ADVERTISEMENTS

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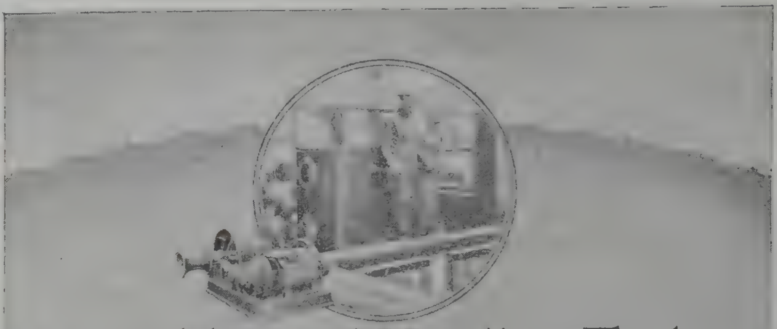

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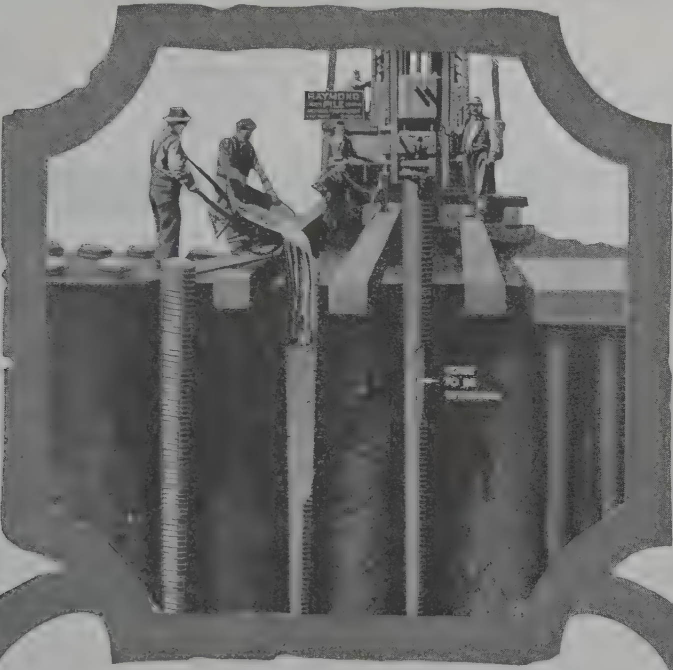

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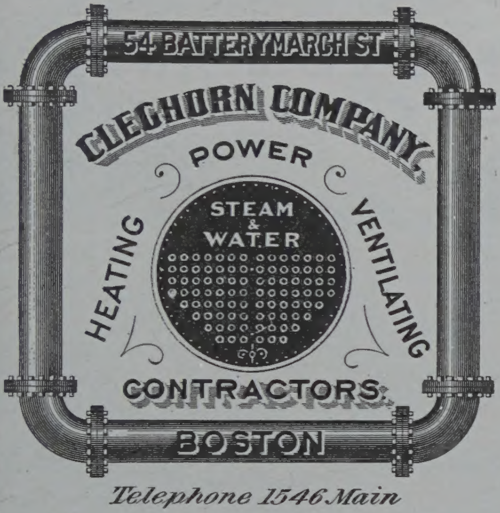

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